KERR-MCGEE
800 WEYRAUCH STREET • WEST CHICAGO, ILLINOIS 60185

February 12, 2002
FLKE-004

PHONE
630-293-6330

VIA FIRST CLASS MAIL

Mr. Fred Micke
U.S. EPA, Region 5
On-Scene Coordinator
Emergency Response Section #3
77 W. Jackson Blvd. (SE-5J)
Chicago, Illinois 60604-3590

SUBJECT: Response to USEPA Comments Dated 1/29/02 re: Investigation Work Plan

REFERENCE: DuSable Park, Chicago, IL

Dear Mr. Micke:

Thank-you for reviewing Kerr-McGee's revised Investigation Work Plan for the proposed limited site investigation at the DuSable Park Site in Chicago, IL. Kerr-McGee has prepared this response letter and attached a revised Investigation Work Plan for your review and approval.

Changes to the November 12, 2001 Investigation Work Plan arising from your twenty new comments have been highlighted in ***bold italics font*** in the revised Investigation Work Plan. Also, rather than revising Standard Operating Procedures (SOPs) that are in place for other Kerr-McGee projects, several of the SOPs have been replaced with "Work Instructions". Changes from the SOPs to Work Instructions delete entire non-applicable sections and therefore for reasons of clarity, tracking the changes was not done in the new Work Instructions.

Please call me at (630) 293-6374 if you have any questions.

Very truly yours,

KERR-McGEE CHEMICAL LLC

Bernard Bono

Bernard Bono
Senior Engineer

Attachments

cc: Mary L. Fulghum, Esq. (USEPA)

File: DPCH – EPA

INVESTIGATION WORK PLAN

DUSABLE PARK SITE

CHICAGO, ILLINOIS

KERR-MCGEE CHEMICAL LLC

November 12, 2001

Revised February 12, 2002

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SOP WCP 347	Decontamination
SOP WCP 363	Operation and Calibration of the Canberra HPGe Gamma Detector
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SOP WCP 379	Calibration of the Ludlum Scaler Ratemeter Model 2221

SCOPE AND OBJECTIVES

This Investigation Work Plan provides an overview of work that will be done to determine whether the four anomalies located by the U.S. EPA represent buried thorium residuals or surface concentration anomalies. The work will be performed at the DuSable Park Site (Site) located in Chicago, Illinois. The location of the Site is shown on Figure 1. The Site is currently a vacant parcel heavily overgrown with tall weeds and scrub trees.

Kerr-McGee Chemical LLC (Kerr-McGee) is performing this investigation. Kerr-McGee, through its own personnel and qualified contractors, will investigate four specific areas of the Site, previously identified by the U.S. EPA as having surface gamma readings above background levels. These four areas are shown on Figure 2.

The Investigation Work Plan describes the work to be performed, health and safety issues, and includes the ***Work Instructions and Standard Operating*** procedures ***(SOPs)*** to be used. ***The Work Instructions to be used include surface gamma survey, soil sampling, sample preparation, and downhole gamma logging.*** The standard operating procedures ~~(SOPs)~~ that will be used include ~~surface gamma surveying (SOP 210), downhole gamma logging (SOP 655) and soil sampling (SOP 214)~~ ***Decontamination (SOP 347), Operation of the Canberra HPGe Gamma Detector (SOP 363) and Moisture Analysis (SOP 365)***.

The four investigation areas will be located in the field using a Trimble Pro-XR global positioning system (GPS) unit with a datalogger. This unit will record the northings and eastings of the boreholes to a horizontal accuracy of +/- one meter. These four areas will be surface gamma surveyed to find the surface area with the highest gamma reading. At the point of the highest surface gamma reading in each area, a borehole will be advanced ***vertically downward*** by hand pounding a geoprobe tube down to a depth of two feet. The boreholes will then be gamma logged with a calibrated meter to determine if low-level 11(e)(2) byproduct material is present in concentrations exceeding 7.1 pCi/g. ***All surface gamma survey and downhole gamma logging readings will be collected as quality data.***

If the gamma logging count rates do not increase with depth, then the surface activity does not represent buried material. If count rates do increase, the hole could be advanced to refusal to determine the thickness and activity of the substrata material exceeding the cleanup criteria. If material exceeding the cleanup criteria is encountered at depth, up to four step out holes may be performed at each location to collect additional information regarding the horizontal extent. Additional investigation beyond the above-described stepouts would change the current scope of this investigation and would require a revision to this Investigation Work Plan.

Soil samples will be collected using a hand auger in accordance with ~~Section 11.2 of~~ the attached soil sampling ***Work Instruction*** ~~procedure, SOP 214~~. The soil sample will be collected at a depth corresponding to the ***interval 3" above to 3" below the*** highest downhole gamma reading. ***Samples will be homogenized in the field and rocks, sticks and foreign objects greater than approximately one-inch will be removed. The field sample will then be split with the U.S. EPA who may then choose to do additional screening and homogenizing in the field.***

The samples will be prepared ***in the lab*** in accordance with ***the sample preparation Work Instruction*** ~~SOP 364~~, ***moisture corrected in accordance with SOP 365,*** and analyzed for the U-238,***Th 232 & U-235*** decay series using the Canberra HPGe Gamma Detector in accordance with SOP 363.

REPORTING

A report of the investigation results will be submitted to the U.S. EPA within 60 days after the borings are completed. The report will include a map of anomaly areas showing the borehole locations, surface gamma readings, downhole gamma logs and soil sample results. The soil sample results will include radionuclide identities, activity concentrations and the depths below surface of the samples.

ACCESS

The Kerr-McGee Field Investigation Leader will obtain access to the land parcels comprising the Site from the respective property owner (Chicago Park District) prior to beginning investigative activities. This access will include permission for Kerr-McGee and U.S. EPA employees, contractors, agents, consultants, designees, and representatives to conduct actions required as part of this investigation. The Environmental Access Agreement form has been included as Figure 3. Kerr-McGee will provide the U.S.EPA with a minimum of two business days notice prior to the start of the limited Site investigation.

UTILITIES

Utilities will be located prior to performing any ground intrusive activity on the property. The Field Investigation Leader will be responsible for originating a request for a DIGGER Utility Locate for each property where drilling is proposed. The phone number for DIGGER is 1-312-744-7000. DIGGER clearances are valid for fourteen days.

DESCRIPTION OF CREW

Delineation drilling boreholes will be advanced by hand pounding the geoprobe pipe using a heavy weight. The crew typically consists of a driller and a helper to advance the borings. In addition, a Health Physics (HP) technician will be present to perform the surface gamma survey, downhole gamma logging, ***soil sampling*** and decontamination tasks. A Kerr-McGee Field Investigation Leader will also be on site to oversee the work.

HEALTH AND SAFETY

The Field Investigation Leader will ensure all work is done in a safe and proper manner. A brief tailgate meeting will be conducted on site before initiating work to explain potential hazards that may be encountered during the work. Potential hazards which could be encountered during investigation activities include contaminated soil materials, contact with trespassers sleeping in the weeds, hazards associated with lifting and hand-pounding holes, contact with utilities, and contact with wild parsnip.

Constituents of concern that could be encountered during investigation activities include low-level 11(e)(2) byproduct material present in concentrations exceeding the action criteria. This may include U-238, Th-232 and progeny. U-235 would be expected to be present in a ratio of 0.0456 times the activity of U-238.

The mechanisms for exposure for these materials are direct exposure, inhalation, ingestion, and eye/skin contact. The primary mechanism for exposure is direct exposure to external gamma radiation. All workers will be instructed in appropriate safety measures to protect against exposure to the above materials.

Trespassers shall be addressed in a courteous and professional manner, however if they become hostile or aggressive, the crew will vacate the work area and call the Chicago Police Department for assistance.

The site is heavily covered with wild parsnip, which can be a strong skin irritant on sunny days. The crew will be instructed to wear long sleeve shirts and gloves at all times they are working in the tall weeds area.

It is anticipated that the investigation work can be done in Modified Level D PPE. Modified Level D PPE for the project includes steel toed or OSHA approved safety work boots or shoes, disposable work gloves, and safety glasses. All visitors must have appropriate PPE and must be accompanied by the Field Investigation Leader.

If monitoring indicates ***that contamination is present at the surface, above action criteria levels of 7.1 pCi/g, then a restricted access area will be created at the perimeter of known contamination, with an appropriate buffer. If work must be performed in an area with surface contamination above action criteria levels, then*** the senior HP technician ***will*** ~~may~~ upgrade the PPE requirements to include disposable coveralls, rubber booties and ***cotton*** ~~neoprene~~ gloves. Any upgrades in PPE will be at the discretion of the attending HP and will be based on the activity of the material encountered and the task being performed.

All workers and visitors will follow decontamination procedures in accordance with SOP 347 ***and with Nuclear Regulatory Commission levels in Regulatory Guide 1.86 and, only if more restrictive, to State of Illinois regulatory levels*** if they come into contact with low-level 11(e)(2) byproduct material in concentrations exceeding the action criteria. Before leaving the exclusion zone, site personnel shall be checked through use of a hand-held frisker to ensure that contamination is not present on skin or chlothes.

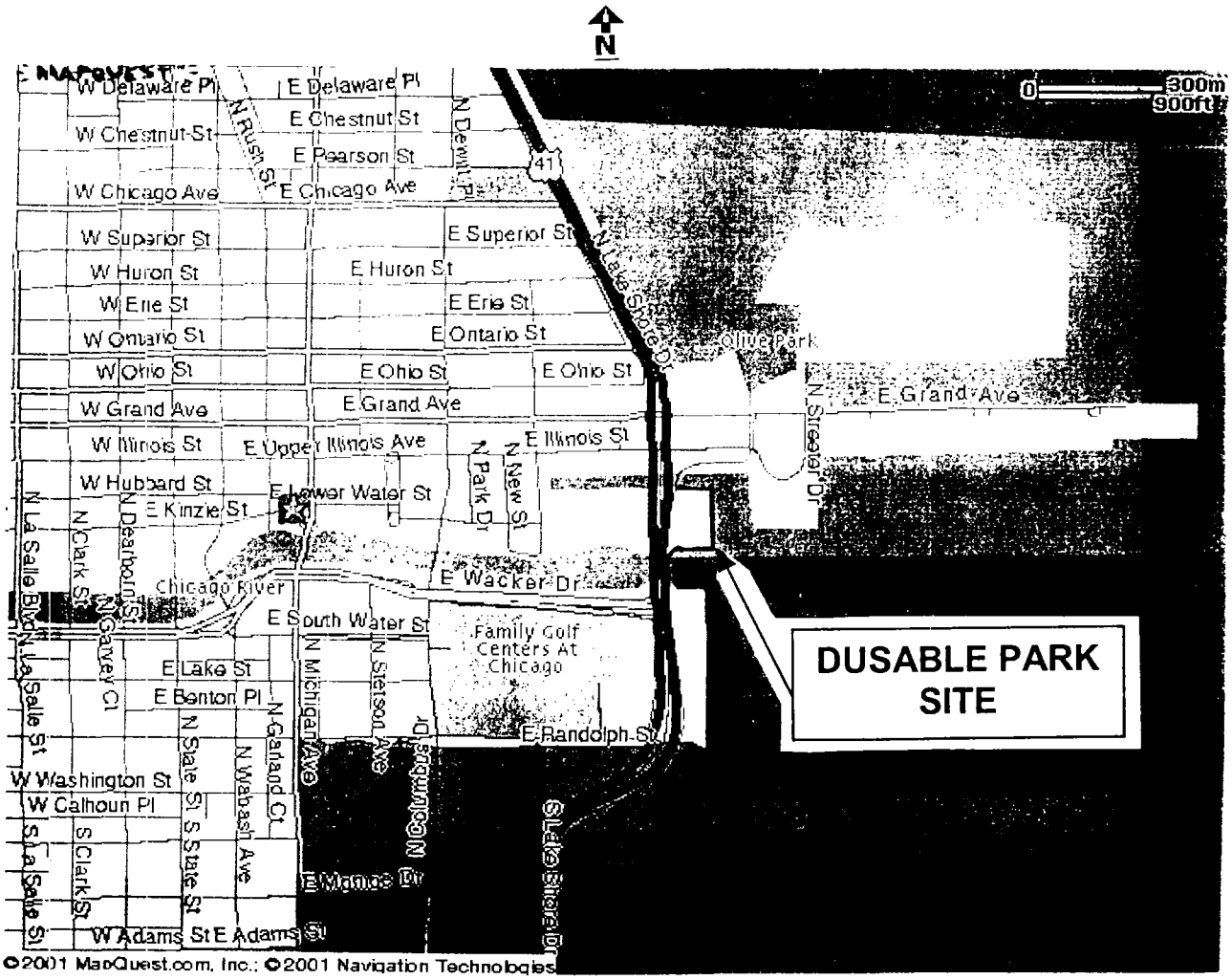

FIGURE 1 – SITE LOCATION MAP

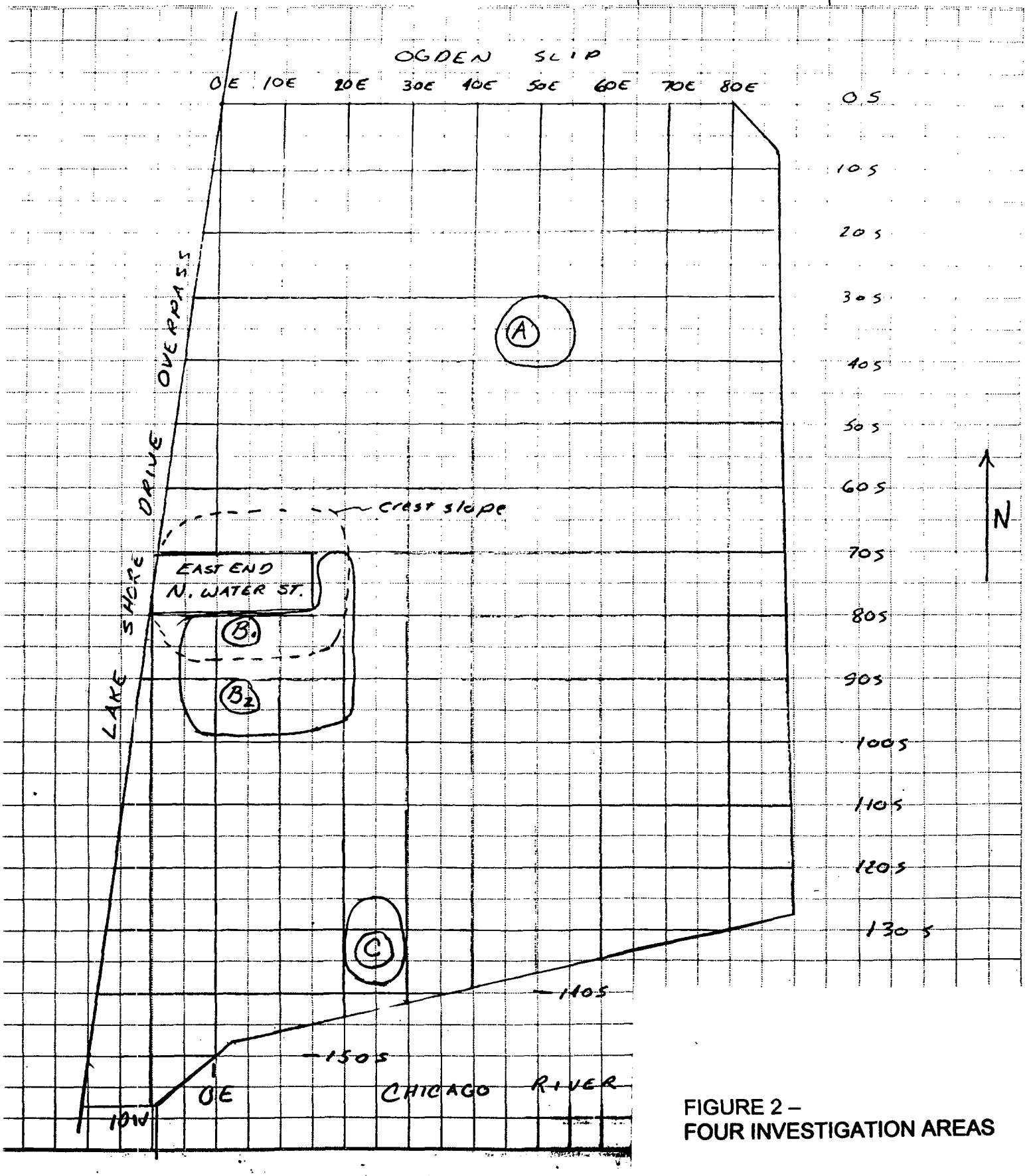

FIGURE 2 –
FOUR INVESTIGATION AREAS

ENVIRONMENTAL ACCESS AGREEMENT

1. I (we), the undersigned, do hereby grant to Kerr-McGee Chemical LLC ("Kerr-McGee"), its employees, authorized representatives and contractors; United States Environmental Protection Agency ("U.S. EPA"), its representatives and contractors; license and permission to enter upon owner's property described as:

   Property Address/Location:

   for the purpose of conducting environmental investigation activities. Kerr-McGee is not U.S. EPA's representative with respect to liability associated with the Chicago Streeterville Area Projects.

2. Upon conclusion of the investigation activities, Kerr-McGee shall remove all its equipment, and disturbed areas shall be restored, to the extent practical, to original conditions.

   Dated this _____ day of _____, 2002.

Owner(s):

Phone# _____

_____

_____

_____

File: DPCH-

DuSable Park

Surface Gamma Survey Work Instruction

Date: February 6, 2002

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1. PURPOSE

This work instruction provides direction for surface gamma radiological survey work to be performed for the limited site investigation at DuSable Park in Chicago, Illinois.

2. SCOPE

Radiological surveys will be performed at the Site as part of the limited Site investigation

3. REFERENCES

3.1 REF Facility Procedure - SOP-WCP 376 "Portable Survey Instrument Operability Checks"

3.2 REF Facility Procedure - SOP-WCP 379 "Calibration of the Ludlum Scaler Ratemeter Model 2221."

4. EQUIPMENT AND MATERIALS

The following equipment may be used as part of the survey programs. Other equipment may be substituted if necessary because of availability of the items listed or the conditions encountered at the site.

4.1 Trimble Pro XR GPS unit with a datalogger to record the northing, easting and count rate of each surface gamma survey point.

4.2 2-inch by 2-inch NaI (T1) gamma detector.

4.3 Ludlum Model 2221 portable scaler ratemeter analyzer.

4.4 Weedwacker (if necessary).

5. INSTRUCTIONS FOR RADIOLOGICAL SURVEY

5.1 Navigate to EPA anomaly areas using GPS unit.

5.2 Clear brush for gamma survey walkover survey.

5.3 Locate point of highest surface gamma reading in each of the four anomaly areas.

5.4 The Ludlum ratemeter is set for 2-second time-weighted average count rate.

5.5 Hold the survey meter probe perpendicular to the ground surface at a height of approximately two to six inches.

5.6 Walk along back and forth over the survey area on one-meter grid lines at a maximum speed of about 0.5 meters per second (1 mile per hour).

5.7 Continue surveying for a minimum ten-meter radius or until readings approach background around the highest reading in each area

6. RECORDS/REPORTS/NOTIFICATIONS

The following documents will be maintained as quality records:

- Field Logbooks
- Map of gamma survey locations
- Data downloads from GPS unit data logger

DuSable Park

Soil Sampling Work Instruction

Date: February 6, 2002

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1. PURPOSE

This work instruction provides direction for collecting soil samples and splitting them with the U.S. EPA as part of the limited site investigation at DuSable Park in Chicago, Illinois. Kerr-McGee's split samples will be submitted to Kerr-McGee's laboratory for counting in a one-liter Marinelli geometry. The samples will be moisture corrected and analyzed for the U-238, Th-232 & U-235 decay series using the Canberra HPGe Gamma Detector.

2. SCOPE

The DuSable Park samples will be collected from the area with the highest surface gamma survey reading in each of the four anomaly areas identified by the U.S. EPA. The Field Investigation Leader will coordinate the sampling efforts.

3. REFERENCES

3.1 Surface Gamma Survey Work Instruction for DuSable Park

3.2 U.S. Nuclear Regulatory Commission, NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination, June 1992.

4. EQUIPMENT AND MATERIALS

4.1 Equipment and Materials Management

Downhole and sampling tools are cleaned in accordance with the Decontamination Procedure (SOP-WCP347).

4.2 Sampling Equipment and Materials

Equipment used for soil sampling includes the following:

- Auger or other Coring Tool

- Shovel and Trowel
- Plastic Collection Bags
- Plastic Sheets (optional)
- Sampling Tracking Form
- Field Logbook
- Container (for collecting potentially contaminated waste generated during the sampling process) (e.g., gloves, plastic sheets, etc.)
- Bucket or stainless steel mixing bowl (for homogenizing samples)
- Appropriate Personal Protective Equipment
- Paper Towels for decontamination
- Survey Instrument (for verifying clean sampling equipment and hands)

Other equipment may be substituted if necessary because of availability of the items listed or the conditions encountered at the site. Substitute equipment shall be documented in the Field Logbook and approved by the Field Investigation Leader.

5. IN-SITU SOIL SAMPLING

This section describes the methods for choosing sample locations and sampling methods.

5.1 Sample Location Selection

The soil sample will be collected at a depth corresponding to the interval 3" above to 3" below the highest downhole gamma reading

5.2 Drilling Procedures

In general, manual or power-auger assisted drilling will be used. Drilling will follow the procedures described in Section 7.2.

6. SAMPLE TRACKING

To establish the documentation necessary to track the sample from the time of collection, the sample identification and Sample Tracking Forms must accompany samples that are sent to the laboratory. If potential contamination is indicated (material history, etc.) the outside of the sample container will be screened for loose contamination.

7. SAMPLING METHODS

7.1 Surface Soil Sampling

7.1.1 If necessary, to minimize contamination, spread a clean sheet of plastic next to the area to be sampled; assemble the sampling equipment required.

7.1.2 Enter the complete information on the Sample Tracking Form:

- ξ Sample Number
- ξ Sample Matrix
- ξ Sample Location
- ξ Purpose of Sample Collection
- ξ Include applicable comments regarding the sample, location, weather, conditions, or other factors that may be relevant
- ξ Collected by (your name).

7.1.3 Mark the collection bag or prepare the identification tag for the sample.

7.1.4 Collect the soil samples from the six-inch interval corresponding to the depth of the highest downhole gamma log reading. Use a shovel or trowel to collect soil from the depth required.

7.1.5 If the soil sample is taken from the uppermost six-inch layer at the surface, the top three inches of soil must not be discarded. This should include the dirt around the grass and plants.

7.1.6 Place the representative soil sample in containers and stir to ensure homogeneity and sample uniformity, if necessary. Remove rocks, sticks, and foreign objects greater than approximately one (1) inch. A one-inch sieve can be used if necessary.

7.1.7 Split the sample with the U.S. EPA.

7.1.8 Attach the identification tag to the sample bag if appropriate and place the bag in the sample container.

7.1.9 Decontaminate the sampling equipment as required by Section 8.

7.1.10 Return any location markers (such as pin flags) that were removed in order to sample. Fill in all sampling holes to eliminate a possible tripping hazard.

7.1.11 If specific data are not available, mark a pin flag with the sample identification number and place the flag at the center of the sampling location before leaving.

7.2 Subsurface Sampling (Undisturbed Soils)

7.2.1 If necessary, to minimize contamination, spread a clean sheet of plastic next to the area to be sampled; assemble the sampling equipment required.

7.2.2 *Enter the complete information on the Sample Tracking Form:*

- Sample Number
- Sample Matrix (i.e., substance)
- Sample Location
- Purpose of Sample Collection
- Include applicable comments regarding the sample, location, weather, conditions, or other factors that may be relevant
- Collected by (your name)

7.2.3 Mark the collection bag or prepare the identification tag for the sample.

7.2.4 Sample the material using a hand core sampling tool or hammer driven split spoon sampler. Collect the soil samples from the six-inch interval corresponding to the depth of the highest downhole gamma log reading. Use a shovel or trowel to collect soil from the depth required. Alternatively, an auger method may be used.

Using an auger, drill to the desired sampling depth; keep the auger turning until no more material comes up. The soil around the hole is fairly well mixed and representative of the interval just drilled. Origin surface material adjacent to or far away from the hole will not be part of the sample.

If the soil sample is to be obtained from a particular depth (not a composite from surface to depth), and the material refuses to pass into the coring tool, the following sampling method will be performed. Drill to the top of the desired sampling depth; keep the auger turning until no more material comes up. Remove the auger and sample the material using a hand core sampling tool or hammer driven spilt spoon sampler. The first three inches of the sampled obtained in this particular instance will be considered slough and not part of the desired sample.

NOTE: If, due to the conditions of the sampling area, this method does not work, an alternative method(s), approved by the Field Investigation Leader, may be used. Alternative methods, when used, will be documented by the field personnel in the Field

7.2.5 If the soil sample is taken from the uppermost six-inch layer at the surface, the top three inches of soil must not be discarded. This should include the dirt around the grass and plants.

7.2.6 Place the representative soil sample in containers and stir to ensure homogeneity and sample uniformity, if necessary. Remove rocks, sticks, and foreign objects greater than approximately one (1) inch. A one-inch sieve can be used if necessary.

7.2.7 Split the sample with the U.S. EPA.

7.2.8 Using a hand trowel, collect approximately one (1) quart of the augured soil in the plastic sample bag or jar. For core segments, place each 6-9 inch (nominally 5-7 inch) segment in the plastic sample bag or jar.

7.2.9 Label the sample container.

7.2.10 Return unused material to the sampling hole and fill in the hole to eliminate possible tripping hazard.

7.2.11 Decontaminate the sampling equipment as required by Section 8.

7.2.12 When required, mark a pin flag with the sample identification number and place the flag at the center of the sampling location before leaving.

7.3 *Soil Sample Size*

Each soil sample collected for radiological analyses will be a minimum of four (4) pounds and should not exceed 10 pounds. Sample size requirements are detailed in Work Instruction for Sample Preparation Procedure for Gamma Spectral Analysis.

8. EQUIPMENT CLEANING

To avoid cross-contamination, the sampling equipment will be cleaned prior to and between samples. The following steps will be followed to clean equipment.

Remove loose contamination by gently tapping/shaking the item.

Using a stainless steel brush or paper towels, remove material that did not dislodge.

If the item appears to be clean (i.e., no visible clinging soil), proceed to the next sampling area.

If the item does not appear to be clean or if a survey with the appropriate instrument does not verify that it is, scrub the item with water. While holding the item over the sampling location, rinse the item with water.

Dry the item with paper towels or repeat the scrubbing sequence as necessary.

Dispose of cleaning materials, plastic sheeting, and associated items as contaminated materials in accordance with instructions provided by the Field Team Leader.

9. QUALITY CONTROL

9.1 QC Samples

To evaluate the variance in the soil sampling protocol, field duplicates will be collected at least once per sampling event and at a minimum of one duplicate per 20 samples specified intervals. These QC samples will be identified and noted in the Field Logbook.

The duplicate will be taken from the homogenized sample collected from one of the four sampling areas. The duplicate will be randomly selected and identified before the sampling begins.

9.2 Data Review

Entries in the Field Logbook will conform to the Field Logbook Standard Operating Procedures, (SOP-215).

The Field Investigation Leader and QA Assistant will resolve any discrepancies that were noted by field personnel in the Field Logbook. See SOP-215 regarding Field Logbook procedures and protocols.

NOTE: Discrepancies relating to reported data will be brought to the attention of the Field Investigation Leader or Offsites Project Manager.

10. HEALTH AND SAFETY

Personal protective equipment and clothing, as required by the Health and Safety Section of the Investigation Work Plan, will be used when collecting and handling contaminated soils.

The site radiological conditions will be determined and documented before sampling begins.

11. RECORDS

The following documents will be maintained as quality records:

- Field Logbooks
- Sampling Tracking Forms
- Results of all Calculations and Statistical Analyses Performed

SAMPLE TRACKING FORM

Date: Page ____ of ____

Sample Number	Matrix (S/W)	Location	Collected For	Comments	Collected By
All samples have been surveyed for removable contamination. None was detected.				Technician	Date/Time

Released by/Company	All samples are listed above are hereby released except for:	Date/Time
Received by/Company	All samples are listed above are hereby received except for:	Date/Time
Received by/Company	Data for all samples listed above are hereby received except for:	Date/Time

DuSable Park

Sample Preparation Work Instruction

Date: February 6, 2002

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1. PURPOSE

This work instruction provides direction for sample preparation work to be performed as part of the limited site investigation at DuSable Park in Chicago, Illinois. Kerr-McGee's split samples will be submitted to Kerr-McGee's laboratory for counting in a one-liter Marinelli geometry. The samples will be moisture corrected and analyzed for the U-238, Th-232 & U-235 decay series using the Canberra HPGe Gamma Detector.

2. SCOPE

Kerr-McGee's laboratory will accept the soil samples collected in the field and prepare them following for gamma spectral analysis according to these instructions.

3. REFERENCES

3.1 State of Illinois Department of Nuclear Saftey Radioactive Material License Number STA-583

3.2 Soil Sampling Work Instruction for DuSable Park

3.3 REF Facility Procedure - SOP-WCP 363 "Operation and Calibration of the Canberra HPGe Gamma Detector"

3.4 REF Facility Procedure - SOP-WCP 365 "Moisture Analysis"

3.5 REF Facility Procedure - SOP-WCP 380 "Use of Laboratory Standard Reference Methods Procedure"

4. EQUIPMENT AND MATERIALS

4.1 Tools, Material, Equipment

4.1.1 The following equipment is needed to perform this procedure:

a. 20 ml sample vials

b. A set of sieves ranging from one-inch to 100 mesh.

c. Bico-Braum Pulverizer

d. Riffle splitter

e. 2 qt plastic jars

f. aluminum pans

g. 4-inch Braum-Chipmunk Crusher

h. analytical balance

i. Marinelli beakers

j. zip-lock bags

k. labels

l. drying oven

4.2 Precautions, Limits

4.2.1 Personnel are to use extreme caution when using the "Chipmunk Crusher" and the "Pulverizer" because they can cause a serious injury.

4.2.2 All samples not known to be homogeneous must be homogenized prior to analysis.

4.3 Acceptance Criteria

Proper preparation ensures that the samples submitted to the laboratory are representative of the material sampled and suitable for the requested analysis.

5. SAMPLE PREPARATION METHODS

5.1 Marinelli Samples

The samples will be counted in a one-liter Marinelli geometry. The samples. The samples will be placed in a plastic collection bag and shall

weigh between four and ten pounds in accordance with the Soil Sampling Work Instruction for DuSable Park.

5.2 Sample Receiving

5.2.1 All samples are brought to the sample receiving area and the following information is documented in the "Sample Log".

a. Sample ID or address

b. Technician receiving samples

c. Date/time received

5.2.2 If the samples are not uniquely identified, assign a unique number to each sample and identify the number(s) on each sample and in the Sample Log.

5.2.3 Prepare the sample in accordance with the requirements of the analysis requested.

5.2.4 Sample(s) received for IDNS and/or USEPA are logged as received in the Sample Log Book. The appropriate agency is notified to pick up the sample(s) from the site laboratory. When samples are picked up, note the date and time in the Sample Log Book.

5.3 Sample Homogenization

Samples received by the lab will be placed into a clean container for blending. Soil clumps that would not fit into the Marinelli geometry will be broken. The soil will be blended using a steel trowel until an even consistency and color (as visually estimated by the lab personnel) is obtained.

5.4 Sample Container Preparation

5.4.1 The tare weight of the empty sample container shall be recorded.

5.4.2 The one-liter Marinelli sample container shall be filled in a manner that minimizes air voids in the soil matrix.

5.4.3 The sample shall be weighed using an analytical balance.

5.4.4 The sample weight shall be moisture corrected in accordance with SOP-WCP 365 "Moisture Analysis". The moisture corrected weight and sample ID number are then written on the lid of the Marinelli

sample container.

5.4.5 The lid is securely attached to the container and the sample is ready for gamma spectral analysis in accordance with SOP-WCP 363 "Operation and Calibration of the Canberra HPGe Gamma Detector".

6. RECORDS/REPORTS/NOTIFICATIONS

The following documents will be maintained as quality records:

- Samples shall be retained until all evaluations have been completed and the sample is no longer needed.

- Log Books shall be maintained by the Lab Supervisor until complete and then forwarded to Document Control for storage in the project files.

DuSable Park

Downhole Gamma Logging Work Instruction

Date: February 6, 2002

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1. PURPOSE

This work instruction provides direction for downhole gamma logging work to be performed as part of the limited site investigation at DuSable Park in Chicago, Illinois.

2. SCOPE

Downhole gamma logging will be used primarily to quantify presence of, if any, low-level 11(e)(2) byproduct material present in concentrations exceeding the criteria of 7.1 pCi/g as defined in the U.S. EPA Unilateral Administrative Order (UAO) for the Lindsay Light II Site. The gamma probe is lowered into the test hole and measurements are recorded in six-inch increments.

3. REFERENCES

3.1 Surface Gamma Survey Work Instruction,

3.2 REF Facility Procedure - SOP-WCP 345 "Surveys of Surface Contamination and Release of Equipment For Unrestricted Use"

3.3 REF Facility Procedure - SOP-WCP 347 "Decontamination"

3.4 REF Facility Procedure - SOP-WCP 376 "Portable Survey Instrument Operability Checks"

3.5 REF Facility Procedure - SOP-WCP 379 "Calibration of the Ludlum Scaler Ratemeter Model 2221."

4. REQUIREMENTS

4.1 The Health Physics (HP) Supervisor shall ensure that all HP or other approved technicians who will be performing the health physics duties in accordance with this procedure have been trained and understand their role and responsibilities.

4.2 HP or other technicians approved by the HP Supervisor shall ensure that all portable survey equipment used in accordance with this plan is properly functioning and has valid calibration and daily source check stickers. Portable survey equipment shall be source checked daily in accordance with REF Facility Procedure – SOP-WCP 376. The observed counts per minute value corresponding to 7.1 pCi/g for the Ludlum 2221 Ratemeter must be recorded in the appropriate blank on the Borehole Field Log sheet.

5. DELINEATION DRILLING METHODS

5.1 Responsibility

The Offsites Manager or designee is responsible for implementing this activity. The Offsites Manager will appoint a Field Investigation Leader to supervise field activities, maintain records and otherwise conduct QC duties as described in this procedure.

5.2 Equipment, Materials and Tools

5.2.1 Manual equipment to advance test holes.

5.2.2 Trimble Pro-XR GPS unit to record the northing and easting of each test hole.

5.2.3 Ludlum 2221 Digital Ratemeter with a model 44-62 0.5" x 0.5" thallium-activated sodium iodide [NaI(Tl)] scintillator to perform test hole gamma logging.

5.3 Drilling and Gamma Logging Procedures

5.3.1 Utilities will be located prior to performing any ground intrusive activity on a property. The Field Investigation Leader will be responsible for originating a request for a DIGGER Utility Locate for the Site. The phone number for DIGGER is 1-312-744-7000.

5.3.2 Each test hole will be located using the Trimble Pro-XR GPS unit to navigate to the point of the highest surface gamma reading located during the surface gamma survey.

5.3.3 A hollow 2"-diameter O.D. drill pipe will be advanced into the ground by manual means to a depth of 24 inches (2 feet) below grade surface. This depth may be extended, if required, as outlined in Paragraph 5.3.7.

5.3.4 The HP will lower the model 44-62 probe into the geoprobe into the borehole to a depth just below the existing ground surface. This

will be considered the 0" reading. The gamma rate will be recorded following a one-minute counting time. Data will be recorded on the "Borehole Field Log Sheet" provided in this procedure.

5.3.5 The HP will then lower the model 44-62 probe into the geoprobe to a depth six-inches below grade surface. At depth, the gamma rate will be recorded following a one-minute counting time. The model 44-62 probe will then lowered to the bottom of the drill pipe in six-inch increments and the gamma rate will be recorded following a one-minute counting time at each six-inch increment. One-minute counts will be accurate because the probe is calibrated using one-minute counts. Data will be recorded on the "Borehole Field Log Sheet" provided in this procedure.

5.3.6 If downhole gamma logging results for the boring in the center of each anomaly indicate that 11(e)(2) byproduct material may be present in concentrations exceeding 7.1 pCi/g, additional test holes may be stepped-out in subsequent five-meter increments until results indicate concentrations are less than the criteria for the full vertical extent of the test hole.

5.3.7 During test hole gamma logging, if the gamma measurements are increasing with depth, the test hole will be further advanced to achieve two or more successive six-inch increment readings with decreasing readings or until refusal. The field logs will include an explanation of the refusal or other pertinent comments if the bottom two readings are not decreasing with depth.

5.3.8 The HP Supervisor or his designee is responsible for reviewing the gamma logs for completeness and data inconsistencies in a timely manner. The Field Investigation Leader is responsible for collecting the reviewed gamma logs from the HP Supervisor.

5.3.9 Physical obstructions (i.e. tree, rock, or topography) may prevent test holes from being located at the necessary measured location or from being extended to the minimum required depth of 24-inches. If this occurs, an alternate location should be used that is as close to the preferred location as reasonable and practical.

5.4 Physical Survey and Mapping

The physical location of every test hole will be recorded using the GPS unit. The location of completed test holes will be shown on field maps produced using GPS associated mapping software. Maps will be prepared under the supervision of the Field Investigation Leader.

The Field Investigation Leader is responsible for comparing the map of

completed field test holes to the surface gamma survey and gamma log data to ensure that the test holes cover the study area in accordance with this plan.

6. RECORDS/REPORTS/NOTIFICATIONS

The following documents will be maintained as quality records:

- Field Logbooks
- Test hole gamma logging sheets
- Map of test hole locations
- Data downloads from the GPS unit data logger.

BOREHOLE FIELD LOG

Page _____ of _____

Date: ____________________ Time: ____________________ Field Technician Name: ____________________

Property: ____________________ Property Parcel ID No.: ____________________

Instrument Model/Serial Number: 2221/ ____________________ Probe Model/Serial No.: 44-62/ ____________________

Response Check: Before ____________ (cpm)

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

Hole #: __________
East: __________
North: __________
Elev.: __________
______ cpm = 7.2 pCi/g
Type: 2" Geoprobe Pipe

Depth	Counts (cpm)
0"	
6"	
12"	
18"	
24"	
30"	
36"	
42"	
48"	
54"	
60"	

SURVEYS FOR SURFACE CONTAMINATION AND RELEASE OF EQUIPMENT FOR UNRESTRICTED USE

1.0 SCOPE

1.1 Purpose

This procedure provides the methods for the detection and measurement of radioactive contamination within the site areas, it provides the methods for evaluating contamination, and establishes the criteria for releasing equipment or materials out of the Exclusion Zone. These methods are to be used to minimize the spread of radioactive contamination.

1.2 Applicability

This procedure applies to surveys that are performed on building surfaces, vehicles, equipment, materials (herein referred to as equipment) at the site and to the site personnel, who are required to monitor and release the equipment.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 *32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to* Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 NUREG CR5849 Manual for Conducting Radiological Surveys in Support of License Termination

2.5 State of Illinois Department of Nuclear Safety License Number STA-583

3.0 DEFINITIONS

3.1 Beta-Gamma to Alpha Decay Ratio

A thorium-232 decay series produces about 0.5 beta-gamma decays for every one alpha decay. This ratio allows the limits for alpha contamination to be verified using beta-gamma survey instruments.

3.2 Clean Area

This term defines radiation conditions within a specified area. An area where the radiation levels and contamination levels are maintained below 2 mrem/hr and 33 dpm/100 cm^2 alpha respectively.

3.3 Contamination Surveys

An assessment that may include, as appropriate, surveys for loose and fixed contamination through the use of direct frisks, large area wipes and smears, to locate and quantify the radioactive material present.

3.4 Exclusion Zone

The area on one side of the Control Line that includes Contamination Control Areas, Radiation Areas, and Airborne Radioactivity Areas.

3.5 Large Area Wipes

Paper towels or maaslin used to wipe large areas to identify the presence of loose contamination.

3.6 Lower Limit of Detection (LLD)

The smallest amount of a radionuclide in a sample that will be detected with a probability of non-detection (Type 1 error) while accepting a probability of erroneously detecting that radionuclide in a blank sample (Type II error). These probabilities are 0.05 (5% chance of Type I or II errors). See Attachment 5 - "LLD Calculation" sheet.

3.7 Smears

Typically 2 inch disk type paper material. Smears are normally taken to identify and quantify loose contamination.

3.8 Unrestricted Release

Release of equipment or materials from the Exclusion Zone to any destination other than a licensed facility.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 Health Physics personnel shall ensure that all portable survey equipment used for this procedure are properly functioning and have a valid calibration sticker.

4.1.2 The Health Physics Supervisor or designee shall ensure that all personnel who are required to perform this procedure are properly trained and understand this procedure.

4.1.3 Equipment, vehicles and areas should be free of visible dirt, mud or dust prior to performing a contamination survey.

4.2 Tools, Material, Equipment

4.2.1 The following counting equipment, or their equivalents, should be used for performing contamination surveys on equipment and materials:

- Eberline PAC-4G gas proportional survey meter coupled to an AC-21 probe or equivalent.
- Eberline PRM6 rate meter coupled to an HP-210 shielded GM detector or equivalent.
- Gamma Products G5000 automatic alpha/beta counting system or equivalent.
- Eberline E-530 survey meter with an HP-270 tissue equivalent GM detector or equivalent.
- Eberline RD-14 Alpha counting system or equivalent.

4.2.2 Survey Maps (or lists) should be produced for each applicable type of equipment. Sketches of building surfaces (walls, floors, etc.), identifying the surveyed grids, should be produced for each surveyed building.

4.3 Precautions, Limits

4.3.1 Direct and removable surveys should not be performed on wet surfaces, for alpha contamination. Wet surfaces should be surveyed only for beta-gamma contamination. However, the Health Physics Supervisor shall make the final determination as to when a wet surface is to be surveyed.

4.4 Acceptance Criteria

4.4.1 Prior to unrestricted release from the Exclusion Zone, all vehicles,

equipment and materials shall be surveyed for contamination. If contamination is found, then the vehicle, equipment, or material should be decontaminated in order to be within the applicable surface contamination release limits per Attachment #3 and Attachment 6 (Beta-Gamma Survey of Truck Tires) shall be used as a guideline for meeting Department of Transportation (49CFR173.443) release criteria, when performing surveys on wet surfaces.

4.4.2 The release of items from clean areas within the Exclusion Zone will be controlled by specific criteria established on a case by case basis and approved by the Health Physics Supervisor.

5.0 PROCEDURE

5.1 Routine Surface Contamination Surveys

5.1.1 Routine surveys shall be performed by trained personnel (typically by Health Physics Technicians), in accordance with this procedure and as scheduled by the Health Physics Supervisor.

5.1.2 Routine contamination surveys are not required in the Exclusion Zone.

5.1.3 Support Zone and Contamination Reduction Zone shall be surveyed at least weekly to ensure that cross contamination is not occurring. The clean side of the Contamination Reduction Zone should be surveyed each work day.

5.1.4 Other surveys will be performed, as appropriate, to support Special Work Permits, the movement of equipment from radioactive material areas to clean areas, and to evaluate radiological conditions in specific work areas when directed by the Health Physics Supervisor.

5.2 Support/ Contamination Reduction Zone- Surface Contamination Surveys

5.2.1 Survey techniques may employ the use of large area wipes, smears, or direct frisks as appropriate to the area being surveyed.

5.2.2. Large area wipes may be used to assess floor areas for contamination. A sufficient number of large area wipes should be used to evaluate approximately 10% of the floor area being surveyed.

5.2.3 If contamination is found with the large area wipes, a more detailed smear survey should be performed.

5.2.4 Counter tops, office furniture, laboratory equipment, etc., should be included in the contamination surveys. The area immediately on the clean side of the Control Line should be included in the survey.

5.2.5 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a sequential number corresponding to the Smear Number on the "Radiological Survey Data Sheet -West Chicago Facility" (see Attachment 1).

5.2.6 The smears shall be analyzed for alpha contamination.

5.3 Equipment- Surface Contamination Surveys

5.3.1 Equipment shall be surveyed for contamination by using large area wipes, smears and by direct frisk as appropriate.

5.3.2 Take an appropriate number of smears to adequately assess the radiological conditions of the item being surveyed.

5.3.3 A large area wipe may be used as an indication of the presence of contamination.

5.3.4 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a sequential number corresponding to the Smear Number on the "Radiological Survey Data Sheet -West Chicago Facility" (see Attachment 1).

5.3.5 The smears shall be analyzed for alpha contamination.

5.4 Unrestricted Release

5.4.1 Materials, equipment and vehicles shall be surveyed for contamination prior to unrestricted release from the site, using large area wipes, smears, and by direct frisk.

5.4.2 All building surfaces, large concrete pieces, and other materials having large, smooth surfaces shall be surveyed prior to unrestricted release. A sufficient number of large area wipes and/or smears shall be taken to adequately assess any contamination present.

5.4.3 All equipment intended for unrestricted release from contaminated areas shall be surveyed for removable and fixed contamination. A sufficient number of large area wipes and/or smears shall be taken to adequately

assess any contamination present. If removable contamination is within the release criteria, then perform a direct alpha frisk. Particular attention should be given to areas of the vehicle most likely to have become contaminated such as tire exterior surfaces, occupied areas, load areas, wheel wells, and the bottom of the equipment.

5.4.4 Vehicles intended for unrestricted release from contaminated areas shall be surveyed for removable contamination with large area wipes. If no contamination is found, take a confirmatory smear to document each large area wipe. If contamination is found, take an appropriate number of smears to evaluate the removable contamination present. If removable contamination is within the release criteria, then perform a direct alpha frisk. All survey results must be documented.

5.4.5 Vehicles intended for unrestricted release from clean areas in the Exclusion Zone shall be surveyed with large area wipes on accessible tire/track surfaces, with a direct frisk of tire/track surfaces, and with one smear each for two tires. The results of the direct frisk and the large area wipes must indicate that the release criteria is met. The smears shall be added to the survey documentation when the results become available.

5.4.6 Large area wipes may be used as an indication of the presence of contamination.

5.4.7 If no contamination is found with a large area wipe, a confirmatory smear shall be taken for documentation.

5.4.8 If contamination is found with the large area wipe, a representative number of smears shall be taken to quantify the removable contamination present.

5.4.9 Smears shall cover approximately 100 cm^2 and should focus on areas with the highest potential for removable contamination. The smears should be placed in an envelope that is labeled with a sequential number corresponding to the Smear Number on the "Radiological Survey Data Sheet-West Chicago Facility" (see Attachment 1).

5.4.10 The smears shall ***either*** be transported to the ***H.P. control line or the soil lab for analysis. Other areas, with the consent of the H.P. Supervisor, can be established for analysis, if conditions warrant them.***

5.4.11 Perform a direct frisk on all material being surveyed for unrestricted release.

5.4.12 Personal equipment and articles (radios, pens, paper, clipboards, etc.) can be surveyed with either the large area wipes or by direct frisk, as appropriate.

> NOTE
> Items that have irregular surfaces, such as radios, should be wiped and frisked. Items with relatively smooth surfaces, such as paper, pens, etc., may be direct frisked only.

5.4.13 Restricted Release of Trucks and Equipment

5.4.13.1 Upon every exit from the South dump pad, health physics will conduct a survey of trucks hauling contaminated material.

5.4.13.2 Large area wipes and direct alpha frisk will be taken on all tires, tailgate and any other suspect area.

5.4.13.3 Large area wipes will be frisked for alpha and/or beta/gamma contamination. Results will be compared against D.O.T. removable contamination limits in 49CFR 173.443 (220 dpm alpha contamination and 2200 dpm beta contamination). If road conditions are wet, refer to Attachment 6 - Beta-Gamma Survey of Truck Tires.

5.4.14.4 At the conclusion of each day worked, all trucks hauling contaminated materials will have four disc smears taken on random tires, in addition to the above large area wipe and direct frisk survey. These smears will then be forwarded to the lab for counting.

5.5 Documentation of Results

5.5.1 The smear counting results and data shall be documented on the "Radiological Survey Data Sheet-West Chicago Facility" (see Attachment 1). The documentation of the unrestricted release survey shall include a drawing of the item to be released.

5.5.2 The instructions for completion of the Radiological Survey Data Sheet are contained in Attachment 2.

5.5.3 A request for equipment release form (Attachment 7) shall be initiated by the equipment owner to track the decontamination process.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 The Health Physics Supervisor and the Site Manager (RSO) shall review and approve all completed survey forms required by this procedure, to comply with reference 2.5 above.

6.2 The survey maps shall be uniquely numbered and retained by Health Physics for project filing. Single item survey maps shall be attached to the survey results.

7.0 ATTACHMENTS

7.1	Attachment 1	Radiological Survey Data Sheet -West Chicago Facility (***E***xample)
7.2	Attachment 2	Radiological Survey Data Sheet Instructions (2 pages)
7.3	Attachment 3	Surface Contamination Release Limits
7.4	Attachment 4	Large Area Wipes on Truck Tires
7.5	Attachment 5	LLD Calculation
7.6	Attachment 6	Beta- Gamma survey of Truck Tires (wet surfaces)
7.7	Attachment 7	Request For Equipment Release ***(Example)***

Attachment 1 *(Example)*

RADIOLOGICAL SURVEY DATA SHEET - WEST CHICAGO FACILITY

PAGE	0F

ITEM DESCRIPTION	00 __ Vehicle	98 __ Equipment	__ __ Building	99 __ Other

REFERENCE #	YR	MO	DAY	ITEM	NO.	PERFORMED BY

ALPHA SURVEY INSTRUMENTATION	BETA SURVEY INSTRUMENTATION

LOCATION	SMEAR NUMBER	ALPHA ACTIVITY (dpm/100cm²)			BETA-GAMMA DIRECT (CPM)
		DIRECT	REMOVABLE	FIXED	

REMARKS

REVIEWED BY:	DATE:

Attachment 2

RADIOLOGICAL SURVEY DATA SHEET INSTRUCTIONS

1. Select the appropriate survey category.

2. Enter the purpose of the survey in the "ITEM DESCRIPTION" section. Be specific:

   - Vehicle survey for release from the site.

   - Tools and equipment for use in the clean area.

   - SWP support, include the SWP number.

3. Enter the survey date.

4. Enter the reference number - Year, Month, Date, Item (Use coding for categories at the top of the form) and Number (Individual survey number issued to each technician by Kerr-McGee).

5. Enter your signature in the "PERFORMED BY" section.

6. Enter the instrument(s), serial number(s), and background reading(s) for the survey instruments used for this survey.

7. Enter the "LOCATION OF READING." Enter descriptions such as, the location and item being surveyed, vehicle number, smear location on vehicle, etc.

8. Enter the number of the smear or large area wipe in the "SMEAR NUMBER" section.

9. All data in the "ALPHA ACTIVITY" section is recorded in dpm/100cm^2, except large area wipe data.

   - If equipment/material is directly frisked, the reading from the PAC-4G is converted to dpm/100cm^2 by multiplying ccpm by a factor of 4 (Gross cpm - Background cpm X 4) and enter the result in the "DIRECT" column. If the instrument response cannot be distinguished from background enter <200 dpm/100cm^2.

RADIOLOGICAL SURVEY DATA SHEET INSTRUCTIONS

- The "REMOVABLE" column may contain the result from a smear or the result from a large area wipe. Smear results that are less than the LLD shall be recorded as less than the numerical LLD value for the instrument in use. As an example, if the LLD for the G5000 is 3 dpm, then the result will should be recorded as <3 dpm/100cm^2. All results should be rounded to the nearest whole number. Results from LAWS should be recorded as dpm without regard to area, unless specific instructions are given to calculate the result per area, as in Attachment 4. Results that do not exceed background should be recorded as BKG (Background).

- Fixed contamination is the difference between the direct frisk results and the removable contamination results. If no fixed contamination is detectable, enter N/A in the "FIXED" column.

10. If a "BETA-GAMMA DIRECT" survey is performed, record the results as ccpm.

11. In the "REMARKS" section, record any identifying data on counting equipment and any other information needed for explanation or interpretation of survey data. If large area wipes are included in the removable contamination data without regard to area, note this in the "REMARKS" section.

Attachment 3

SURFACE CONTAMINATION RELEASE LIMITS

Average[a] Removable (dpm/100 cm^2)	Maximum Removable (dpm/100 cm^2)	Average[a] Fixed (dpm/100 cm^2)	Maximum Fixed (dpm/100 cm^2)
33	100	1,000	5,000
Equivalent Beta-Gamma Measurements[b,c]			
17	50	500	2,500

[a] The contamination levels may be averaged over one (1) square meter provided the maximum activity per any 100 cm^2 area within the one (1) square meter is less than the maximum applicable release limit.

[b] Beta-gamma release limits derived from the beta-gamma to alpha ratio.

[c] Beta-gamma surveys are not normally performed for release purposes. If alpha contamination is verified to be within specified release limits, the alpha to beta-gamma ratio indicates that the beta-gamma is also within limits.

Beta-gamma frisks may be used as appropriate to:

- Estimate contamination levels prior to performing release surveys.
- Estimate levels of contamination present on equipment, materials and work areas.

The results of direct beta-gamma frisks should be quantified on survey records as CCPM (Corrected Counts Per Minute).

Results that are less than 100 CCPM should be recorded on the survey record as <100 CCPM.

Attachment 4

LARGE AREA WIPES ON TRUCK TIRES

Large area wipes are used to wipe an area of approximately 2000 cm^2 on truck tires. The wipes are then frisked with a PAC-4G.

Assuming that 50 cpm above background is readable, it can be assumed that 100 dpm is detectable on a wipe. If the area of the wipe requires two probe areas to cover the wipe, then it can be assumed that we can assess with each measurement approximately half of the total area wiped, or 1000 cm^2, or approximately 100 dpm/1000 cm^2, which is equivalent to 10 dpm/100cm^2.

Frisk results on LAWs, from truck tires, that are nondetectable may be recorded as <10 dpm/100cm^2 in the removable column of the survey report.

ATTACHMENT 5

LLD CALCULATION

$$LLD = \frac{2.71}{T_s} + 3.29\sqrt{(\frac{C_b}{T_b})(1 + \frac{T_b}{T_s})}$$

Where C_b = Background Counts Per Minute
T_b = Background Counting Time in minutes
T_s = Sample Counting Time in minutes

EXAMPLE: The background count rate for a given counter is 1.56 cpm over a 50 minute counting time and samples are counted for 2 minutes. The counter has an efficiency of 40.3%.

$$LLD = \frac{2.71}{2} + 3.29\sqrt{(\frac{1.56}{50})(1 + \frac{50}{2})}$$

$$LLD = 4.32\ cpm$$

$$LLD = \frac{4.32cpm}{.403} = 10.7dpm$$

ATTACHMENT 6

Beta-Gamma Survey of Truck Tires

The Department of Transportation removable contamination limits in 49CFR 173.443 are 220 dpm alpha contamination and 2200 dpm beta contamination. The most restrictive is the alpha limit. If weather prevents surveying for alpha contamination, then beta-gamma surveys will have to be utilized. The alpha to beta ratio for the thorium chain is approximately 2:1. Using an alpha to beta ratio of 2, the beta equivalent activity for the alpha limit would equal 110 dpm. 110 dpm times the probe efficiency of 0.14 cpm/dpm equals 15.7 cpm. 15.7 cpm above background is not discernable in the field. The diameter of a truck tire is 43 inches. The tread width is 9 inches. The surface area of a truck tire equals 7843.8 cm^2. Approximately 12 inches of tread is on the ground and not surveyable. This represents 3.5% of the surface area of the tire. The remaining 96.5% equals a surface area of 7569.5 cm^2. The typical area of contact for a wipe is about 3.5 inches by 4 inches. This is equal to about 90 cm^2. If the conservative area of 100 cm^2 is used the each cm^2 of wipe is equal to 57.7 cm^2 of tread area. The manufacturer lists the surface area of the probe face as 15.5 cm^2. The tread area survey under the probe equals 894.4 cm^2. To correct the measured counts to an activity/100 cm^2 the counts indicated on the meter face must be multiplied by 8.9. If 15.7 cpm/100 cm^2 beta-gamma activity equals 220 dpm/100 cm^2 alpha contamination then the measured cpm when surveying a wipe would equal 139 cpm. The manufacturer recommends limiting the background count rate to less than 300 cpm in order to see 100 cpm above background. Due to the changing background conditions this value is being reduced to 200 cpm. Therefore if background is 200 cpm or less and the wipe on a truck tire reads less than 100 cpm above background the truck tire has less than 220 dpm/100 cm^2 removable alpha contamination.

ATTACHMENT 7 *(Example)*

REQUEST FOR EQUIPMENT RELEASE

FROM:_____ DATE:_____

THROUGH: Construction Management Approval: _____
TO: Health Physics Supervisor

1.Equipment Type and ID# _____

2.Usage history (locations on site): _____

3.Scheduled to begin decon: _____

4. HP check for survey readiness: Tech. initials_____ Date:_____

5. Equipment ready for survey? yes_____ No_____
Actions required: _____

6. Date & Time ready for survey _____

7. Survey Date & Time _____
Results: Pass_____ Fail_____

8. Equipment release date: _____

9. Approved for release _____
HP Supervisor

NOTE: On large earth moving equipment, substantial cleaning may be required prior to HP checking for survey readiness. Once vehicle has been checked and is ready for release survey, it may take as much as 24 hours from the time the survey is initiated until survey results are available. If fixed or removable contamination is located, additional decontamination and surveys are required.

DECONTAMINATION

1.0 SCOPE

1.1 Purpose

The purpose of this procedure is to provide instructions for the decontamination of personnel and equipment.

1.2 Applicability

This procedure is applicable for all equipment and personnel that may become contaminated at the Kerr-McGee West Chicago Facility.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 Kerr-McGee Procedure ***WCP-345*** "Surveys for Surface Contamination and Release of Equipment for Unrestricted Use"

3.0 DEFINITIONS

3.1 Airborne Radioactivity Area

This term defines radiation conditions within a specified area. An area where the average concentration of airborne radioactivity could allow an individual to exceed 12 DAC-hrs over a one week period.

3.2 Clean Area

This term defines radiation conditions within a specified area. An area where the radiation levels and contamination levels are maintained below 2 mr***em***/hr and 33 dpm/100 cm^2 alpha respectively.

3.3 Contamination Control Area

This term defines radiation conditions within a specified area. An area that may be contaminated to a level greater than a Clean Area.

3.4 Contamination Reduction Zone

The area ***on one side*** of the Control Line where personnel ***can decontaminate,*** remove their personal protective clothing and equipment. ***(See "Support Zone Layout" drawing #200-CV-007.)***

3.5 Control Line

The ***demarcation*** that separates ***a*** Clean Area from ***a Contamination Control Area. The control line is located in the personnel decon facility.***

3.6 Craft Personnel

Employees and contractors who physically perform the activities described on the SWP.

3.7 Derived Air Concentration-Hour (DAC-hour)

DAC-hour is the product of the concentration of radioactive material in air and the time of exposure to that radionuclide.

3.8 Exclusion Zone

The area ***on one side of*** the Control Line that includes Contamination Control Areas, Radiation Areas, and Airborne Radioactivity Areas.

3.9 Film Badge

Similar to the TLD, it is used to measure radiation dose.

3.10 Frisking

A personal survey of an individual's clothing and exposed body performed to determine if contamination is present.

3.11 Protective Clothing

Reusable or disposable coveralls, boots and gloves that provide a barrier between contamination and personnel.

3.12 Radiation Area

This term defines radiation conditions within a specified area. An area where the whole body radiation level is greater than 5 mrem/hr.

3.13 Special Work Permit (SWP)

A document which describes the radiological conditions of the work area or task and delineates safety and radiation protection requirements to be followed in the work area or when performing the task.

3.14 Support Zone

The area on one side of the Control Line at the entrance to the Exclusion Zone. ***(See "Support Zone Layout" drawing #200-CV-007.)***

3.15 Thermoluminescent Dosimeter (TLD)

A device that measures radiation dose.

4.0 REQUIREMENTS

4.1 Prerequisites

None.

4.2 Tools, Material, Equipment

4.2.1 Decontamination facility.

4.2.2 Soap, water, high pressure spray, scrub brushes and other material as necessary to decontaminate personnel and equipment.

4.3 Precautions, Limits

Decontamination of personnel with material other than soap and water will only be done when authorized by the Site Manager, Health Physics Supervisor, or a medical doctor.

4.4 Acceptance Criteria

4.4.1 Personnel shall be free of contamination after decontamination.

4.4.2 Material and equipment *being decontaminated, for unrestricted release, shall meet the release limits established in Reference 2.4.*

5.0 PROCEDURE

5.1 Personnel Decontamination

5.1.1 Personnel who are contaminated to greater than 100 *ccpm** shall notify the health physics technician (HPT) assigned to the Control Line.

5.1.2 The HPT shall resurvey the individual to determine the exact location of the contamination and document it on the Contaminated Personnel or Personal Effects Report (Attachment 1).

5.1.3 If the contamination is spotty, the HPT shall attempt to decontaminate the individual using swabs or soap and water. If the decontamination is successful, document the results on Attachment 1.

a. If contamination is determined to be in an individual's eyes, the eyes may be flushed, using an eye wash station.

b. If contamination remains in the eyes after flushing or is determined to be in an individual's nose or ears, decontamination will be performed under the direction of the Health Physics Supervisor or qualified medical personnel.

c. Cleansing methods for skin decontamination, in order of harshness are as follows:

1. Lifting off with sticky tape.

2. Flushing with water.

* ccpm = Corrected counts per minute
total counts per minute
minus background.

3. Soap and cool water.

4. Mild abrasive soap, soft brush, and water.

5. Detergent (soap powder).

6. Mixture 50% powdered detergent and 50% cornmeal.

5.1.4 If the contamination cannot be easily removed or the contamination is wide spread, the HPT shall escort the individual to the decontamination facility and notify the Health Physics Supervisor and the Site Manager.

5.1.5 The contamination shall be removed by having the individual wash with soap and cool water several times if necessary. The methods listed above may be used by the HPT.

5.1.6 If the decontamination is successful, document the results on Attachment 1.

5.1.7 If, after several attempts, the contamination is not successfully removed, notify the Health Physics Supervisor.

5.2 Tool Decontamination

5.2.1 All tools being removed from the Exclusion Zone shall be checked by the HPT.

5.2.2 Tools that are contaminated shall be decontaminated before they can be released from the Exclusion Zone.

5.2.3 Tools shall be decontaminated by the users under the direction of the HPT.

5.2.4 Tools can be decontaminated using scrub brushes and soap and water, wiping with damp rags or wipes, soaking in a decontamination solution, using abrasive materials ultrasonic cleaners, or any other method approved by the HPT.

5.2.5 All interior surfaces of the tools must be decontaminated as well prior to the tool being unconditionally released.

5.2.6 If the tool is decontaminated and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet **(Reference 2.4).**

5.2.7 If the tool cannot be decontaminated after several tries, then the tool shall be painted or sprayed with yellow paint to indicate that the item is radioactive material and kept in the Exclusion Zone.

5.3 Equipment Decontamination

5.3.1 Heavy equipment, such as backhoes, bulldozers, trucks, cranes, shall be washed with high pressure water spray prior to being surveyed by the HPT.

5.3.2 The washing of heavy equipment shall be performed in an area designated by health physics.

5.3.3 Once the equipment is washed, it will be surveyed by the HPT. The HPT will identify any areas on the equipment that need further decontamination and will make recommendations on how to further decontaminate.

5.3.4 All surfaces of the equipment must be decontaminated and surveyed. This includes air intakes, air filters and any internal surface that is likely to be contaminated.

5.3.5 Once the equipment has been surveyed and released by the HPT, the survey results shall be documented on a Radiological Survey Data Sheet ***(Reference 2.4)***.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Release surveys and personnel decontaminations shall be documented on the appropriate form.

6.2 Personal contaminations shall be reported to the Health Physics Supervisor and the Site Manager.

7.0 ATTACHMENTS

7.1 ***Attachment 1 Contaminated Personnel or Personal Effects Report***

ATTACHMENT 1

CONTAMINATED PERSONNEL OR PERSONAL EFFECTS REPORT

DATE OF INCIDENT	TIME OF INCIDENT
NAME	BADGE NO
LOCATION OF INCIDENT (SPECIFIC AREA)	

DESCRIPTION	DESCRIBE IN DETAIL ANATOMICAL LOCATION, CONTAMINANT, TYPE OF INJURY, OR CONTAMINATED ARTICLE.

CONTAMINATED ARTICLE OR AREA	DECONTAMINATION AGENT USED	INSTRUMENT	SURVEY RESULTS BEFORE	SURVEY RESULTS AFTER	FINAL DISPOSITION OF ARTICLES

WOUND COUNT /5 MIN	BKGD COUNT /5 MIN	SOURCE COUNT /5 MIN

SAFETY MEASURES	PERTINENT SAFETY MEASURES IN EFFECT ☐ YES ☐ NO	IF NO, EXPLAIN

REMARKS	

EMPLOYEE SIGNATURE	HEALTH PHYSICS SIGNATURE

OPERATION AND CALIBRATION OF THE CANBERRA HPGe GAMMA DETECTOR

1.0 SCOPE

1.1 Purpose

The Canberra HPGe detector system is used for the non-destructive x-ray and gamma ray spectral analysis of environmental and site operations media. This procedure describes the general operational steps for routine analysis and calibration. Calibrations are performed in reproducible, standardized geometries to ensure accuracy and precision of analytical results.

1.2 Applicability

This procedure applies to the quantitative and qualitative x-ray and gamma ray analysis of environmental and site operations media. Quantitative analyses are performed only on standardized geometries. Qualitative analyses are performed for identification purposes only, including any non-standard media.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 State of Illinois Department of Nuclear Safety Radioactive Material License Number STA-583

2.5 Canberra PROCOUNT Operations Manual

2.6 Canberra Germanium Detectors User's Manual

2.7 Canberra Operating Manuals (the equations for calculating sample activity)

2.8 Amersham Certificate of Calibration (DV648)

3.0 DEFINITIONS

None.

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 The system records live time, clock time and dead time and stores this information with the sample spectra. Live time is used for all sample activity calculations.

4.2 Tools, Material, Equipment

4.2.1 Digital Equipment Company (DEC) MicroVax 3000 workstation or equivalent.

4.2.2 Canberra high-purity germanium (HPGe) detector or equivalent. The HPGe detector(s) is a reverse electrode type, with very thin ion implanted electrode. The cryostat is topped with a very thin aluminum endcap. This combination maximizes sensitivity for low energy photopeaks by offering improved resolution along with flatter efficiency response. The detector(s) is approximately 50 mm diameter by 50mm thick and around 25% efficient (relative to a 3" X 3" Nal(T1)).

4.2.3 Canberra spectroscopy amplifier Model 9645 or equivalent.

4.2.4 Canberra high voltage power supply Model 9645 or equivalent.

4.2.5 Canberra analog-to-digital converter (ADC) Model 9633 or equivalent.

4.2.6 Canberra acquisition interface module (AIM) Model 556 or equivalent.

4.2.7 Canberra nuclear instrumentation BIN Model 2100 or equivalent.

4.2.8 Nuclear Data remote parallel interface (RPI) or equivalent.

4.3 Precautions, Limits

4.3.1 Background checks will be performed on a daily or prior to use basis.

4.3.2 Instrument response or efficiency checks will be performed on a daily or prior to use basis.

4.3.3 NIST traceable standards should only be used for calibrations.

4.3.4 Amersham Mixed Gamma Standards do not require coincidence/summing corrections. NIST SRM 4276C Mixed-Radionuclide Solution Standard requires corrections for coincidence/summing.

4.4 Acceptance Criteria

4.4.1 Samples shall be analyzed for a sufficient time to achieve the required sensitivities. Typically counting times of 15 to 1000 minutes are used.

The Project required sensitivities vary for soil, water and air particulate samples. Attachment *1* provides the sensitivity for 1500 grams of soil in a one-liter Marinelli beaker geometry, using a 1000 second counting time. Soil sensitivities of ≤ 1 pCi/g for Ra-226 and Ra-228, and ≤ 5 pCi/g for U-238, using appropriate progeny, are adequate for both the off-Site (Superfund) and on-Site (Rare Earth Facility) projects.

5.0 PROCEDURE

5.1 Initial Detector Electronics Setup

5.1.1 Menu items can typically be selected by typing the option number and selecting the return function key. Alternately, the menu item can be highlighted by using the up and down arrow keys and selecting the PF1 function key.

5.1.2 Verify or establish the high voltage power supply settings.

NOTE: Polarity is critical and should be noted and recorded in the maintenance log. If polarity is changed the detector will be damaged.

5.1.2.1 Click on the MCA option box located in the left margin of the MCA Window using the mouse.

5.1.2.2 Click on the Adjust option box located in the left margin of the MCA Window.

5.1.2.3 Click on the HVPS option box. Confirm that the initial settings are as follows:

Voltage:	3500 V.
Status:	On
Over/Inh. State:	Clear
Over Latch:	Disable
Inh. Latch:	Disable
Inh. Signal:	5 V.

5.1.3 Verify or establish the amplifier gain settings.

5.1.3.1 Click on the MCA option box located in the left margin of the MCA Window.

5.1.3.2 Click on the Adjust option box located in the left margin of the MCA Window.

5.1.3.3 Click on the AMPLIFIER option box. Confirm that the initial settings are as follows:

Coarse Gain:	X2.5
Fine Gain:	(adjustable)
S-Fine Gain:	1.0000X
BLR Mode:	Sym
PUR:	On
Preamp Type:	RC
Shaping Mode:	Gaussian
Shaping Time: 4 μSec	
Input Mode:	Normal
Input Polarity: Negative	
LTC Mode:	Normal
Inh. Polarity:	Positive

5.1.3.4 The fine gain adjustment is described in the following section.

5.1.3.5 Log the amplifier gain settings in the HPGe logbook.

5.1.4 Verify or establish the initial ADC Settings

5.1.4.1 Click on the MCA option box located in the left margin of the MCA Window using the mouse.

5.1.4.2 Click on the Adjust option box located in the left margin of the MCA Window.

5.1.4.3 Click on the ADC option box. Confirm that the initial settings are as follows:

Conv. Gain:	8192
Offset:	0
LLD:	2.00%
ULD:	110%
Zero:	± 0.500%
Acq. Mode:	PHA
Anticoinc.:	Coinc
Late Coinc.:	Early
Peak Detect:	Auto
Xfer Timing:	Overlap
LTC/PUR:	LG

5.1.5 Establish or verify the amplifier gain and ADC zero settings.

5.1.5.1 Place a mixed gamma calibration standard that includes at least two well-spaced photon energies spanning the energy calibration range of interest. A mixed gamma standard containing a low energy nuclide such as Cd-109 (88.03 keV) and a high energy nuclide such as Y-88 (1836.01 keV) should suffice.

5.1.5.2 Click on the Acquire On option box in the left margin of the MCA window to initiate spectral data acquisition.

5.1.5.3 Note the peak centroid channel locations for the 88-keV and 1836-keV lines. The recommended peak channel locations for a nominal ***0.5*** keV/channel system gain are as follows:

Nuclide	Energy(keV)	Peak Channel
Cd-109	88.03	176 ±2
Y-88	1836.01	3672 ±2
Difference	1747.98	3496 ±2

5.1.5.4 Calculate the peak channel difference for the 88-keV and 1836-keV photon lines and compare to the preceding table.

5.1.5.4.1 If the observed channel difference is too small, increase the amplifier gain setting by clicking on the Fine Gain option box with the mouse and adjusting.

5.1.5.4.2 If the observed channel difference is too large, decrease the amplifier gain setting by clicking on the Fine Gain option box with the mouse and adjusting.

5.1.5.5 Erase and acquire a new gamma spectrum by clicking on the Clear option box and repeat above steps until the desired channel difference is achieved.

5.1.5.6 Record any changes to the amplifier settings in the HPGe counting log and proceed to ADC Setup.

5.1.6 Analog-to-Digital Converter (ADC) Setup

5.1.6.1 Note the peak centroid channel location of the 1836-keV gamma line and compare to preceding table.

5.1.6.1.1 If the observed peak centroid channel location is less than the desired channel location, increase the ADC zero setting.

5.1.6.1.2 If the peak centroid channel location is greater than the desired channel location, decrease the ADC zero setting.

5.1.6.1.3 Erase and acquire a new gamma spectrum and repeat above steps until the desired peak channel location is achieved.

5.1.6.2 Record any changes to the ADC zero settings in the counting room log.

5.2 Calibrations

5.2.1 Initial Energy/Shape Calibration

5.2.1.1 This is the initial energy and peak shape calibration. This type of calibration is only performed when initially setting up the HPGe detector system for the first time. Performing additional calibration geometries is described in the next section.

Efficiency vs. energy curves are established (or re-established) each time the HPGe detector is calibrated see 5.2.2).

5.2.1.2 Select option #1 Gamma Counting from the Sample Counting Main Menu.

5.2.1.3 Select option #6 Calibrate a Detector from the Gamma Count Main Menu.

5.2.1.4 Select option #1 Energy/Shape Initial Calibration from the Detector Calibration Main Menu.

5.2.1.5 Select the desired detector at the Nbr Detector Name prompt from the Detector Main Menu.

5.2.1.6 Enter the analysis live time in seconds at the Preset Live Time prompt. The default time format is in seconds. Spectrum acquisition times should be sufficient to obtain well resolved photopeaks with at least 10,000 net counts in each of the photopeak areas.

5.2.1.7 Enter a "Yes" at the Wait for Acquisition prompt.

5.2.1.8 Place a NIST traceable source on the detector in the geometry of interest. A mixed gamma reference source with non-interfering calibration energies spanning the nominal energy range of 80 to 2000 kev should be used.

5.2.1.9 Enter a Return function key to continue with the Calibration.

5.2.1.10 Enter a Y (Yes) at the "Would you like to use the spectrum presently in the detector prompt".

5.2.1.11 Enter a N (No) at the Do you want to turn acquisition off to calibrate prompt.

5.2.1.12 Enter the Select function key at the option #1 Energy Calibration and option #2 FWHM Calibration prompt to select both energy and FWHM calibration options. The options will be underlined indicating both are selected.

5.2.1.13 Select the appropriate calibration certificate number option at the Certificate Menu prompt.

5.2.1.14 Move the mouse and cursor to the low energy photon peak and select option #1 low energy peak to highlight.

5.2.1.15 Move the mouse and cursor to the high energy photon peak and select option #2 high energy peak to highlight.

5.2.1.16 Enter the PF1 function key to accept low and high energy peak marker information.

5.2.1.17 Select the Perform/Update Calibration option at the Calibration Main Menu.

5.2.1.18 Select the Review option at the Calibration Review Main Menu. Energy calibration results should be within ± 2 percent of the known energies. The fitted shape or FWHM calibration results should be within ± 15 percent of the experimentally observed FWHM shapes.

5.2.1.19 Enter the PF3 Exit function key to update calibration information.

5.2.2 Energy/Shape/Efficiency Calibration

5.2.2.1 Select option #1 Gamma Counting from the Sample Counting Main Menu.

5.2.2.2 Select option #6 Calibrate a Detector from the Gamma Count Main Menu.

5.2.2.3 Select option #2 Energy/Shape/Efficiency Update Calibration from the Detector Calibration Main Menu.

5.2.2.4 Select the desired detector at the Nbr Detector Name prompt from the Detector Main Menu.

5.2.2.5 Enter the analysis live time in seconds at the Preset Live Time prompt. The default time format is in seconds. Spectrum acquisition times should be sufficient to obtain well resolved photopeaks with at least 10,000 net counts in each of the photopeak areas.

5.2.2.6 Enter a "Yes" at the Wait for Acquisition prompt.

5.2.2.7 Place a NIST traceable source on the detector in the geometry of interest. A mixed gamma reference source with non-interfering calibration energies spanning the nominal energy range of 80 to 2000 keV should be used.

5.2.2.8 Enter a Return function key to continue with the Calibration.

5.2.2.9 Enter a Y (Yes) at the "Would you like to use the spectrum presently in the detector" prompt.

5.2.2.10 Enter a N (No) at the Do you want to turn acquisition off to calibrate prompt.

5.2.2.11 Enter the PF1 Select function key at the option #1 Energy Calibration option #2 FWHM Calibration and option #3 Efficiency prompt to select all three calibration options. The options will be underlined indicating selection.

5.2.2.12 Select the appropriate calibration certificate number option at the Certificate Menu prompt.

5.2.2.13 Move the mouse and cursor to the low energy photon peak and select option #1 low energy peak to highlight.

5.2.2.14 Move the mouse and cursor to the high energy photon peak and select option #2 high energy peak to highlight.

5.2.2.15 Enter the Select function key to accept low and high energy peak marker information.

5.2.2.16 Select the Perform/Update Calibration option at the Calibration Main Menu.

5.2.2.17 Select option #1 Energy, #2 FWHM, #3 Efficiency at the Calibration Review Main Menu.

5.2.2.18 Enter the PF3 Exit function key to update calibration information.

5.2.2.19 Enter a Y (Yes) at the Would you like to generate calibration report prompt.

5.2.2.20 Review the Calibration Report and ensure that the residuals from the fitted values as compared to the experimentally observed values are within the following acceptance criteria:

FWHM:	± 15 %
Efficiency:	± 10 %

5.2.2.21 Verify the efficiency calibration by analyzing a known standard of the same geometry as a sample as described in the following section.

5.3 Routine Operations

5.3.1 Daily Checks

5.3.1.1 The Efficiency checks are performed as follows:

5.3.1.1.1 Place the check source in the proper counting geometry on the HPGe detector.

Note: A record of the check is maintained in the computer.

5.3.1.1.2 Select option #1 Gamma Counting from the Sampling Counting Main Menu.

5.3.1.1.3 Select option #5 Quality Control from the Gamma Counting Main Menu.

5.3.1.1.4 Select option #1 Calibration Check from the Quality Control Menu.

5.3.1.1.5 Select the desired detector at the Nbr Detector Name prompt from the Detectors menu.

5.3.1.1.6 Select the proper geometry option.

5.3.1.1.7 Select the appropriate quality control certificate option at the Nbr Certificate Name prompt from the Certificate Files Menu.

5.3.1.1.8 Place the check source for the geometry and QA file sleeted in step G on the detector and Enter a Return to begin acquisition. Data acquisition will automatically begin for the preset time established in the quality control check file.

5.3.1.1.9 Review the Calibration Check report and confirm the low and high energy points have passed the bounds test for the following information:

Peak Centroid
Peak FWHM
Peak Efficiency (Decay Corrected Activity)

5.3.1.1.10 If any of the parameters fail, repair the obvious (such as a faulty energy calibration) and repeat check.

5.3.1.1.11 ***Deleted***

5.3.1.2 Background Checks are performed as follows:

5.3.1.2.1 Open the shell door and check to ensure counting cave is empty. Close shell door prior to proceeding.

Note: A record of the check is maintained in the computer.

5.3.1.2.2 Select option #1 Gamma Counting from the Sampling Counting Main Menu.

5.3.1.2.3 Select option #5 Quality Control from the Gamma Counting Main Menu.

5.3.1.2.4 Select option #2 Background Check from the Quality Control Menu.

5.3.1.2.5 Select the desired detector at the Nbr Detector Name prompt from the Detectors menu.

5.3.1.2.6 Verify step 5.3.2.a. prior to proceeding and Enter a Return to start acquisition. Data acquisition will automatically begin for the preset time established in the background control check file.

5.3.1.2.7 Review the Background Check report for the presence of significant peaks indicating contamination. Decontaminate detector or detector chamber as necessary.

5.3.1.3 ***Deleted***

5.3.2 Routine Sample Analysis

5.3.2.1 Place the sample in the proper counting geometry on the HPGe detector.

5.3.2.2 Record sample identification information in the Germanium Sample Log.

5.3.2.3 Select option #1 Count a Sample from the Gamma Counting Main Menu.

5.3.2.4 Select option #1 the desired detector at the Nbr Detector Name prompt from the Detectors Menu.

5.3.2.5 Select option desired analysis sequence from the Nbr Analysis Name prompt.

5.3.2.6 Select the appropriate sample geometry at the Nbr Geometry prompt from the Geometry Files menu.

5.3.2.7 Place sample on detector in appropriate geometry configuration. Enter a RETURN to continue. The system will respond with the Acquisition has started message.

5.3.2.8 Enter the Preset Live Time in seconds at the prompt, if needed. They are normally pre set already.

5.3.2.9 Enter the Sample ID at the prompt.

5.3.2.10 Enter the Sample Quantity or mass in grams.

5.3.2.11 Enter the desired Sample Units (i.e., grams) at the prompt. Normally, units are pre-set.

5.3.2.12 Enter the Sample Date/Filter End Date and Time at the prompt.

5.3.2.13 Record Sample Number End from prompt as File # in the Germanium Sample Log.

5.3.2.14 Review or edit inputs as necessary and select the PF1 function key to process/accept information.

5.3.2.15 The system message Submitting the procedure which waits for acquisition to finish will be displayed on the monitor. The

analysis report will be printed at the completion of counting (see example Attachment #1).

5.2.3.16 At the completion of counting, analysis results will be stored to a results file on the MicroVax computer.

5.2.3.17 Select the PF3 function to return the counter to the Sample Counting Main Menu.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Submit all ***results to*** the ***H***ealth ***P***hysics ***S***upervisor.

7.0 ATTACHMENTS

7.1 Attachment #1 HJPGe detector minimum detectable activities (MDA) as calculated per US-NRC regulatory Guideline 4.14. (Example)

7.2 Attachment #2 ***Deleted***

Attachment 1
(Example)
Page 1 of 8

Kerr-McGee Gamma Report Generated 15-JUN-1995 08:50:22

Configuration : DKA200:[GAMMA.SCUSR.ARCHIVE]BKG_MARINELLI_GE1_MARINELLI_6831.CNF;1

---- Sample Information ----

Sample Title	:		
Sample ID	: Marinelli	Sample Quantity	: 1.00000E+00 EA
Sample Type	:	Sample Geometry	:
Sample Number	: 6831	Spctrm Collector	: RAY LANCASTER
Analyzed By	:		

---- Sample Deposition Information ----

Dep. Correction?	: No	Dep. Duration	:
Deposition Start	:	Deposition End	: 17-FEB-1995 00:00:00

---- Sample Decay/Count Information ----

Sample Date	: 17-FEB-1995 00:00:00	Acquisition date	: 17-FEB-1995 15:07:19
Decay time	: 0 15:07:19.21	% dead time	: 0.1%
Elapsed live time	: 0 00:16:40.00	Elapsed real time	: 0 00:16:40.95

---- Detector Parameters ----

Energy cal. time	: 13-FEB-1995 12:10:32	Energy cal. oper.	: RAY LANCASTER
Detector name	: GE1	Counting geometry	: Marinelli
Effic. cal. time	: 13-FEB-1995 14:34:23	Effic. cal. oper.	: RAY LANCASTER

---- Processing Parameters ----

Start channel	: 50	End channel	: 8192
Sensitivity	: 5.00000	Gaussian Sens.	: 10.00000
Critical level?	: No	Propagate Errors?	: Yes
Empirical Eff?	: Yes	Library-based eff	: Yes
Energy tolerance	: 2.00000	Half life ratio	: 30.00000
Abundance limit	: 75.00000	WTM error limit	: 3.00000
MDA Width (FWHM)	: 3.00000	MDA Confid Level	: 5.00000 %

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	511.35	29	0	1.52	1022.83	1018	12	2.90E-02	18.6	

Interference Report Page : 2
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

No interference correction performed

Summary of Nuclide Activity Page : 3
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Total number of lines in spectrum	1	
Number of unidentified lines	0	
Number of lines tentatively identified by NID	1	100.00%

**** There are no nuclides meeting summary criteria ****

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Nuclide Line Activity Report Page : 4
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Flag: "*" = Keyline

Unidentified Energy Lines Page : 5
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

It	Energy	Area	Bkgnd	FWHM	Channel	Left Pw	Cts/Sec	%Err	%Eff	Flags
0	511.35	29	0	1.52	1022.83	1018 12	2.90E-02	37.1	1.32E+00	T

Flags: "T" = Tentatively associated

Rejected Report Page : 6
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Nuclide	Half-life	Half-Life Ratio	Energy	%Abund	2-Sigma Activity	%Error	Rejected by
TL-208	1.41E+10Y	0.00	74.96	3.34	--- Not Found ---		Abun.
			84.90	1.52	--- Not Found ---		
			510.84	21.60	2.738E-04	45.73	
			583.14*	84.20	--- Not Found ---		
			860.37	12.46	--- Not Found ---		
			2614.66	99.80	--- Not Found ---		
		% Abundances Found =		9.69	(Abn. Limit = 75.00%)		

Flag: "*" = Keyline

Minimum Detectable Activity Report Page : 7
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

Nuclide	Bckgnd Sum	Energy (keV)	MDA (pCi/EA)
K-40	6.	1460.81	3.8628E+02
TL-208	4.	583.14	1.8799E+01
PB-210	9.	46.50	4.2948E+02
BI-212	6.	727.17	3.0388E+02
PB-212	11.	238.63	2.6746E+01
BI-214	5.	609.31	3.7202E+01
PB-214	5.	351.92	3.0523E+01
RA-226	19.	186.21	3.9854E+02
AC-228	2.	911.07	5.6099E+01
TH-230	6.	67.67	1.9249E+03
PA-234M	8.	92.59	1.2858E+02
TH-234	8.	92.59	1.2858E+02
U-235	16.	185.71	2.2349E+01

Combined Activity-MDA Report Page : 8
Sample ID : Marinelli Acquisition date : 17-FEB-1995 15:07:19

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/EA)	K.L. Ided	Act error	MDA (pCi/EA)	MDA error	Act/MDA
K-40	1.203E+02		3.339E+02	3.863E+02	6.085E+01	0.311
TL-208	-1.642E+01		2.618E+01	1.880E+01	4.185E+00	-0.873
PB-210	1.809E+02		3.565E+02	4.295E+02	1.598E+02	0.421
BI-212	1.775E+02		2.192E+02	3.039E+02	4.737E+01	0.584
PB-212	6.179E+00		2.457E+01	2.675E+01	5.070E+00	0.231
BI-214	-1.132E+01		4.289E+01	3.720E+01	7.478E+00	-0.304
PB-214	-8.746E+00		3.272E+01	3.052E+01	5.483E+00	-0.287
RA-226	8.464E+01		3.678E+02	3.985E+02	7.249E+01	0.212
AC-228	-1.709E+01		6.757E+01	5.610E+01	9.084E+00	-0.305
TH-230	-8.953E+02		2.240E+03	1.925E+03	3.535E+02	-0.465
PA-234M	-1.519E+03		5.105E+03	1.286E+02	1.951E+01	-11.811
TH-234	-1.153E+01		1.221E+02	1.286E+02	1.951E+01	-0.090
U-235	-4.287E+01		9.668E+01	2.235E+01	4.126E+00	-1.918

MOISTURE ANALYSIS

1.0 SCOPE

1.1 Purpose

This procedure shall be used to determine the moisture content in soils at the West Chicago Project.

1.2 Applicability

This procedure applies to all analyses of moisture in soils at the West Chicago Project.

2.0 REFERENCES

2.1 MAX Moisture Analyzer User Manual.

3.0 DEFINITIONS

3.1 None

4.0 REQUIREMENTS

4.1 Prerequisites

4.1.1 The MAX-50 Moisture Analyzer is operational and warmed up for at least 20 minutes.

4.2.2 The MAX-50 shall be calibrated prior to use.

4.2 Tools and Equipment

4.2.1 Calibration weights, a 10 gram and a 6 gram

4.2.2 Weighing pans, AZI stock number 990-0008-00 or equivalent

4.2.3 MAX-50 Moisture Analyzer

4.2.4 Scale, if not using the MAX-50 Moisture Analyzer

4.2.5 Oven, if not using the MAX-50 Moisture Analyzer

4.3 Precautions, Limits

4.3.1 The MAX-50 Moisture Analyzer uses a heating element in the lid that, while in use, can cause serious burns if in contact with unprotected skin.

4.3.2 The MAX-50 Moisture Analyzer has a max weight capacity of 20 grams.

4.3.3 The balance in the MAX-50 Moisture Analyzer is a precision balance. Care should be used when placing or removing items so that the balance is not damaged.

4.3.4 Gloves shall be worn when handling the calibration weights.

4.3.5 Exercise care when transferring samples in to or out of the oven.

4.4 Acceptance Criteria

4.4.1 The acceptable range for the calibration test on the MAX-50 Moisture Analyzer is between 37.48 - 37.54 %.

5.0 PROCEDURE

5.1 Calibration of the MAX-50 Moisture Analyzer

5.1.1 Verify the analyzer is on and warmed up for at least 20 minutes.

5.1.2 Open the lid and place an aluminum pan onto the sample tray support.

5.1.3 Close the lid and press the start button.

5.1.4 When the "LOAD" light illuminates, press the "% SAMPLE" button.

5.1.5 Open the lid and place the 10 gram and the 6 gram weight on the sample pan.

5.1.6 Close the lid and observe the display. If the balance is operating the display should read 75-85%.

5.1.7 If the display does not read between specified range, press the reset button, remove the calibration weights, and place the analyzer out of service.

5.1.8 Close the lid to start the analysis cycle.

> **NOTE**
> The heat lamp will energize as part of the analysis cycle. Care should be used when opening the lid and handling the weights.

5.1.9 When the heat lamp illuminates, open the lid and remove the 6 gram weight.

> **NOTE**
> Care must be used when removing the weight. If the sample pan is disturbed, the red "SYSTEM FAILURE" light will illuminate and the display will read "1".

5.1.10 If a system failure occurs, press the reset button, remove the calibration weights, and restart the test at step 5.1.5.

5.1.11 Close the lid and wait for the analysis cycle to complete.

5.1.12 When the green "FINAL" light illuminates, indicating the completion of the analysis, the display will indicate the % moisture. If the display does not read 37.48 to 37.54%, place the analyzer out of service.

5.1.13 If the display is within the acceptable range, initial the Lab Daily Routine Sheet for the calibration.

5.1.14 Open the lid and remove the calibration weights, return them to their storage location, and close the lid of the analyzer.

5.2 Moisture Determination Using the MAX 50 Moisture Analyzer

5.2.1 Verify the analyzer is energized and has warmed up for at least 20 minutes.

5.2.2 Verify analyzer calibration by observing the sign off on the Lab Daily Routine Sheet.

5.2.3 Open the lid and remove any sample pans.

5.2.4 Place a sample pan on the sample pan support.

5.2.5 Close the lid and press the "START" or the "HISTART" button.

> **NOTE**
> Maximum sample weight of 20g may be analyzed. The display will

read out the percent of sample. When ***sufficient*** sample has been placed on the sample pan the analyzer will beep and the amber "CLOSE" light will illuminate.

5.2.6 When the load light illuminates, open the lid and place the sample in the sample pan.

5.2.7 When the "CLOSE" light illuminates, close the lid to start the analysis cycle.

5.2.8 When the green "FINAL" light illuminates, the analysis cycle is complete. The display will read the % Moisture.

5.2.9 Record the % Moisture on the Moisture Analysis Log, Attachment 1.

5.2.10 Open the lid, remove the sample pan, and close the lid.

5.2.11 Repeat steps 5.2.4 to 5.2.10 for each sample to be analyzed.

5.3 Moisture Determination using a Scale

5.3.1 Verify the scale to be used has been calibrated for the day by observing the sign off on the Lab Daily Routine Sheet.

5.3.2 Weigh the sample and determine the net weight of the sample.

5.3.3 Dry the sample for at least 24 hours at a minimum of 100 degrees C.

5.3.4 Reweigh the sample and determine the net weight.

5.3.5 Subtract the net weight measured in 5.3.4 from the net weight measured in step 5.3.2.

5.3.6 Divide the value obtained in step 5.3.5 by the weight obtained in 5.3.2 and multiply the value by 100.

5.3.7 Record the value from 5.3.6 as the % Moisture on the Moisture Analysis Log.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Records

6.1.1 Lab Daily Routine Sheet

6.1.2 Moisture Analysis Log

6.2 Retention

Records generated in the performance of this procedure will be retained for the duration of the West Chicago Project.

6.3 Reports

Report analysis results as required for that sample type.

6.3 Notifications

Notify lab supervision of conditions requiring analyzer to be place out of service.

7.0 ATTACHMENTS

7.1 ***Attachment 1*** Typical Moisture Analysis Log

Attachment 1

MOISTURE ANALYSIS LOG

DATE	TIME	MAX-50 USED (Y/N)	SCALE SERIAL #	AS RECEIVED NET WEIGHT	DRY NET WEIGHT	% MOISTURE	TECH INITIALS

APPROVED BY _____ DATE: _____

PORTABLE SURVEY INSTRUMENT OPERABILITY CHECKS

1.0 SCOPE

1.1 Purpose

To provide a means to document the operability of portable survey instruments.

1.2 Applicability

This procedure is required of all project personnel performing radiological surveys using portable instruments.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan for Decommissioning Activities at the Kerr-McGee Chemical Corporation Rare Earths Facility, West Chicago, Illinois

2.4 ANSI N323-1978

3.0 DEFINITIONS

Source Check

A test of an instrument's response to a known radiation field in order to verify operability of the instrument.

4.0 REQUIREMENTS

4.1 Prerequisites

None.

4.2 Tools, Material, Equipment

4.2.1 Calibrated survey meters.

4.2.2 Necessary radioactive sources to verify operability of each type of instrument.

4.3 Precautions, Limits

Do not subject portable survey meters to physical abuse or water.

4.4 Acceptance Criteria

4.4.1 The survey instruments indicate a satisfactory response to the battery check prior to ***each day of use.***

4.4.2 The survey instruments indicate a satisfactory response to the check source (mean ± 20%) prior ***to each day of use.***

5.0 PROCEDURE

5.1 Portable survey instruments will be source ***checked, after*** repair and calibration, or prior to ***each day of use.***

5.2 Alpha Instruments:

5.2.1 Select the desired instruments.

5.2.2 Record the current date and time on Attachment 1.

5.2.3 Check the calibration due date on each instrument to ensure that the calibration has not expired. ***If calibration has expired, go to paragraph 5.4 below.***

5.2.4 Check instrument for satisfactory physical condition. If excessive dents, torn Mylar or loose parts are found, place the instrument out of service.

5.2.5 Perform a battery check and record the results on Attachment 1.

5.2.5.1 Replace the batteries if they are low.

5.2.5.2 ***If the batteries are dead, take the instrument "out of service".***

5.2.6 Perform a source check and record the results in the appropriate columns on Attachment 1.

> NOTE
> The instrument must indicate within ± 20% of the expected response ***(source activity)*** listed on Attachment 1.

> NOTE
> The 43-20 alpha gas probes are interchangeable with the LM-12 count ratemeters. Periodic field checks of the instrument using the source attached to the instrument are required to verify continuing operability. Should the field check indicate no response or a reduced response, return the instrument to determine if the probe requires replacement or the if instrument requires repair.

5.2.7 Source check each quadrant of the Ludlum Model 43-20 alpha probe and record the results in the appropriate column.

5.2.8 Average the four quadrant reading and record this value on Attachment 1.

5.2.9 Record your initials next to each instrument checked on Attachment 1.

5.2.10 If an instrument is ***found to be inoperable,*** note on Attachment 1 why it is ***being placed out of*** service (i.e. out of calibration, ***damage*** repair, etc.) ***and go to 5.4 below.***

5.3 ***Beta*** Gamma Instruments:

5.3.1 Select the desired instruments.
5.3.2 Record the current date and time on Attachment 1.

5.3.3 Check the calibration due date on each instrument to ensure that the calibration has not expired. ***If calibration has expired, go to paragraph 5.4 below.***

5.3.4 Check instrument for satisfactory physical condition. If excessive dents, broken windows, or loose parts are found, place the instrument out of service.

5.3.5 Perform a battery check, and record the results on Attachment 1.

5.3.5.1 ***Replace the batteries if they are low.***

5.3.5.2 ***If the batteries are dead, take the instrument "out of service".***

5.3.6 Perform a ***source*** check with a Cs-137 source and record the results on Attachment 1.

> NOTE
> Reference readings shall be obtained on each instrument when exposed to a check source in a constant and reproducible manner at the time of, or promptly after, ***instrument*** calibration.

5.3.7 Record your initials next to each instrument checked on Attachment 1.

5.3.8 ***If an instrument is found to be inoperable, note on Attachment 1 why it is being placed out of service (i.e. out of calibration, damage repair, etc.) and go to 5.4 below.***

5.4 INSTRUMENT OUT OF CALIBRATION

5.4.1 When a instrument is found to be "out of calibration" or fails ***an operability*** check, immediately notify the HP Supervisor.

5.4.2 Source check failures ("out of calibration") are to be recorded in the instrument log book and a nonconformance report (NCR) shall be initiated per QPM-DOC #9, in order to ***document the necessary corrective action(s) and to allow for management to*** assess trends. ***NCR's are not initiated for***

instruments found with expired calibration due dates, and have not been used.

5.4.*3* The HP Supervisor shall determine the last date that the ***used*** instrument passed a ***source check,*** or the last calibration date, whichever is ***most recent.***

5.4.*4* Based on the last acceptable ***source check or calibration*** date, the HP Supervisor shall ***identify which*** radiological surveys were performed ***since then*** with the defective instrument.

5.4.*5* The HP Supervisor shall determine whether regulatory or general information surveys were performed with the defective instrument.

5.4.*6* Using previous surveys or previous knowledge of the survey data, the HP Supervisor shall determine whether the surveys taken with the defective ***instrument*** are acceptable ***"as is"*** or ***whether*** the surveys must be reperformed. In the case of regulatory surveys, ***they*** shall be retaken, if possible. ***I***f resurveying is not possible, the HP Supervisor will make a written assessment ***as to*** the quality of the data. ***This assessment may also be used to disposition the NCR.***

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Notifications required by the procedure will typically be verbal to the H. P. Suvervisor.

6.*2* Forward the completed Attachment 1 forms to Health Physics Supervision for review.

6.*3* Any instruments that have ***dead batteries or*** failed ***the*** source checks have been removed from service ***and so noted on Attchment 1 and instrument log book.***

6.4 Forward the dispositioned NCR to the Site manager for review and project filing.

7.0 ATTACHMENTS

7.1 Attachment 1 Portable Instrument Accountability Form (Example)

ATTACHMENT 1

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

DATE	TIME	A.M. / P.M.

ALPHA SURVEY INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	SOURCE ACTIVITY	INSTRUMENT RESPONSE	SOURCE ACTIVITY	INSTRUMENT RESPONSE	BATTERY CHECK	REMARKS	INITIALS
PAC-4G w/AC-21 PROBE 1505							
3986							
3992							
4015							
4022							
4044							
4058							
4177							
4178							
6057-02							
6057-03							
6057-04							
6057-05							

ATTACHMENT 1

DATE TIME A.M.

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

P.M.

ALPHA SURVEY INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	SOURCE ACTIVITY	INSTRUMENT RESPONSE	SOURCE ACTIVITY	INSTRUMENT RESPONSE	BATTERY CHECK	REMARKS	INITIALS
PRM-6 w/AC-3 PROBE 647							
653							
736							
765							
779							
1259							
Ludlum 43-20 Alpha Detector w/LM-12 Instrument		**Average Response**		**Average Response**		**Indicate quadrant and response**	
Inst. Number						1 2 3 4	

DATE	TIME A.M. / P.M.

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

ALPHA SURVEY INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	SOURCE ACTIVITY	INSTRUMENT RESPONSE	SOURCE ACTIVITY	INSTRUMENT RESPONSE	BATTERY CHECK	REMARKS	INITIALS
Ludlum 43-20 Alpha Detector w/LM-12 Instrument		**Average Response**		**Average Response**		**Indicate quadrant and response**	
Inst. Number						1 2 3 4	

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

DATE	TIME	A.M. / P.M.

BETA-GAMMA INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	PROBE USED	BATTERY CHECK	HIGH VOLTAGE CHECK	RESPONSE CHECK	REMARKS	INITIALS
PRM-6 648	HP-210					
1263	HP-210					
1270	HP-210					
E-530 410	HP-270					
1133	HP-270					
1180	HP-270					
PRM-7 364	NaI					
699	NaI					
704	NaI					
707	NaI					
H.P.I. 1010 345	IC					

DAILY PORTABLE INSTRUMENT CHECK-WEST CHICAGO FACILITY

DATE	TIME	A.M. / P.M.

BETA-GAMMA INSTRUMENTS

STANDARD S/N

INSTRUMENT TYPE AND SERIAL NO.	PROBE USED	BATTERY CHECK	HIGH VOLTAGE CHECK	RESPONSE CHECK	REMARKS	INITIALS
LUDLUM MODEL 3 113990	44-40					
115345	44-40					
115385	44-40					
115025	44-40					
LUDLUM MODEL 3 114947	44-38					
115046	44-38					
115065	44-38					
115117	44-38					
115375	44-38					

CALIBRATION OF THE LUDLUM SCALER RATEMETER MODEL 2221

1.0 SCOPE

1.1 Purpose

To provide a standard procedure for the calibration of the Ludlum Ratemeter, model 2221 with the 44-10, 44-62 sodium iodide scintillation probes.

The 2221 is a portable, battery operated, self contained counting instrument designed for operation with scintillation, proportional or G-M detectors. When combined with scintillation detectors, the 2221 is used for the detection and measurement of gamma radiation. This instrument is used for down hole gamma logging as well as the detection of surface radioactivity.

1.2 Applicability

This instrument will be calibrated every twelve months, after repairs, or when the instrument readings are questionable. This procedure can be used with any ratemeter/sodium iodide scintillation detector combination. Typically the 44-62 half-inch detector is not used for surface scanning.

2.0 REFERENCES

2.1 32 Illinois Administrative Code, Parts 310 and 340, Standards for Protection Against Radiation

2.2 32 Illinois Administrative Code, Part 400, Notices, Instructions and Reports to Workers; Inspections

2.3 West Chicago Project, Health and Safety Plan Kerr-McGee Chemical Corporation

2.4 Technical Manual for Scaler Ratemeter, Model 2221

2.5 Kerr-McGee calibration standard blocks manufactured by K-M Technology and Engineering Report TR-94013

2.6 Calibration Drum Data 12 July 1995 and Calibration Drum Data from Sewage

Treatment Plant Report

3.0 DEFINITIONS

N/A

4.0 REQUIREMENTS

4.1 Prerequisites

None.

4.2 Tools, Material, Equipment

4.2.1 Small screwdriver.

4.2.2 Ludlum Model 500 pulser or equivalent.

4.2.3 Certified, NIST-traceable source of sufficient activity to allow a response check.

4.3 Precautions, Limit .

4.3.1 The connector cord is easily damaged if the weight of the 44-10 detector is suspended with it.

4.3.2 Do not leave the reading lamp on for any length of time as it will rapidly drain the battery voltage.

4.4 Acceptance Criteria

The instrument response to the certified calibration source should be within ± 20% in order to be acceptable.

5.0 PROCEDURE

5.1 Generic calibration applicable to all detectors.

NOTE: Calibrations for Surface activity and downhole logging are detailed in section 5.2.

5.1.1 Check the battery condition by pressing the "BAT" button with instrument switched on. If the meter does not indicate the battery charge above 5.3

volts, replace the four (4) D-cell batteries.

5.1.2 Set the threshold value as follows:

5.1.2.1 With the instrument turned on, press the threshold button. Read the displayed reading, if necessary adjust the "**THR**" adjustment screw until the threshold reads **100.**

NOTE: The 'THR" adjustment screw is located under the calibration cover.

5.1.3 Set the window value as follows:

5.1.3.1 With the instrument turned on press the "**WIN**" button and observe the reading, if the reading does not indicate approximately **3830** then with the "win button depressed adjust the reading to 3830.

NOTE: The '**WIN**" adjustment screw is located under the calibration cover

5.2 SPECIFIC USE CALIBRATION

5.2.1 Surface Soil concentration Calibration

5.2.1.1 Use attachment 1 for calibration if the instrument is to be used for surface surveying.

5.2.2 Downhole logging

5.2.2.1 If instrument is to be used for downhole logging then proceed to attachment 2 for the calibration procedure.

6.0 RECORDS/REPORTS/NOTIFICATIONS

6.1 Instrument is properly calibrated and available for use or it has been placed out of service for repair.

6.2 Attachments have been reviewed and filed.

6.3 The equipment history has been updated.

7.0 ATTACHMENTS

7.1 Attachment 1 Soil Concentration Calibration Instructions

7.2	Attachment 2	Downhole Logging Calibration Instructions
7.3	Attachment 3	Soil Concentration Calibration Form
7.4	Attachment 4	Calibration Sticker
7.5	Attachment 5	Downhole logging Calibration Data Form

Attachment 1
CALIBRATION OF 2221 WITH 44-10 FOR SURFACE SCANNING

WORK INSTRUCTION

1. Record the instrument and detector serial numbers on attachment 3.
2. Perform a scaler linear check as follows:
   - 2.1 Record the pulser model/serial number on attachment 3
   - 2.2 Record the calibration due date on attachment 3
   - 2.3 Check the threshold setting to insure that it is set at 100mv, if it is not set at 100mv then adjust it in accordance with section 5. .
   - 2.4 Connect the pulser to the instrument.
   - 2.5 Send 400,4000.40K and 400K cpm pulses into the meter
   - 2.6 Record the meter responses in the "AS FOUND"column of attachment 3.
   - 2.7 If the meter does not indicate the correct response to within ± 10% perform the following steps as necessary:
     - 2.7.1 Send 400 cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.2 Send 4000 cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.3 Send 40k cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.4 Send 400k cpm pulses into the meter and adjust the reading for an acceptable reading
     - 2.7.5 Record the resulting readings in the after adjustment column on attachment 3
     - 2.7.6 If unable to adjust to within ± 10% , place the instrument out of service for repair.

1.3 PERFORM A VOLTAGE AND BACKGROUND AS FOLLOWS:

- 1.3.1 Record the source isotope and serial number on attachment 3.
- 1.3.2 Perform a source plateau by exposing the detector to a radioactive source and recording the meter reading at 50 volt increases until a plateau is developed. record the voltage and the meter reading for each increment on attachment 3.
- 1.3.3 At selected voltage increments perform a background reading and record the meter reading on attachment 3 .
  - 1.3.3.1 Set the meter high voltage to between 1/3 and 1/2 of the voltage plateau.
  - 1.3.3.2 Record the selected high voltage setting on attachment 3.

1.4 INSTRUMENT BACKGROUND

- 1.4.1 Perform an instrument ***background*** as follows:
  - 1.4.1.1 Using the four background blocks, perform six - one minute counts (with the instrument set at the selected voltage) and set in the scaler mode.
  - 1.4.1.2 Record these readings on attachment 3
  - 1.4.1.3 Average the six readings and record the result on attachment 3.

1.5 CALIBRATION SOURCE BLOCK DATA

- 1.5.1 Record the source block serial number on attachment 3
- 1.5.2 Perform six one minute source block counts
- 1.5.3 Record the results on attachment 3
- 1.5.4 Average the source block cpm and record the result on attachment 3
- 1.5.5 Subtract the average background (recorded on attachment 3) from the average source block cpm .
- 1.5.6 Record this number as the net average on attachment 3.

1.6 ACTIVITY CALCULATION

1.6.1 Perform the calculation on attachment 3 to determine the activity cutoff value for 7.2 pCi/g.

1.6.2 Sign attachment 3

1.7 CALIBRATION STICKER

1.7.1 Complete the information required on attachment 4 and attach it to the side of the instrument.

Attachment 2

CALIBRATION OF 2221 FOR GAMMA DOWNHOLE LOGGING

WORK INSTRUCTION

1. Record the instrument and detector serial numbers on attachment 3.
2. Perform a scaler linear check as follows:
    - 2.1 Record the pulser model/serial number on attachment 3
    - 2.2 Record the calibration due date on attachment 3
    - 2.3 Check the threshold setting to insure that it is set at 100mv, if it is not set at 100mv then adjust it in accordance with section 5. .
    - 2.4 Connect the pulser to the instrument.
    - 2.5 Send 400,4000.40K and 400K cpm pulses into the meter
    - 2.6 Record the meter responses in the "AS FOUND"column of attachment 4.
    - 2.7 If the meter does not indicate the correct response to within ± 10% perform the following steps as necessary:
        - 2.7.1 Send 400 cpm pulses into the meter and adjust the reading for an acceptable reading
        - 2.7.2 Send 4000 cpm pulses into the meter and adjust the reading for an acceptable reading
        - 2.7.3 Send 40k cpm pulses into the meter and adjust the reading for an acceptable reading
        - 2.7.4 Send 400k cpm pulses into the meter and adjust the reading for an acceptable reading
        - 2.7.5 Record the resulting readings in the after adjustment column on attachment 3
        - 2.7.6 If unable to adjust to within ± 10% , place the instrument out of service for repair.

1.3 PERFORM A VOLTAGE AND BACKGROUND AS FOLLOWS:

- 1.3.1 Record the source isotope and serial number on attachment 3.
- 1.3.2 Perform a source plateau by exposing the detector to a radioactive source and recording the meter reading at 50 volt increases until a plateau is developed. record the voltage and the meter reading for each increment on attachment 4.
- 1.3.3 At selected voltage increments perform a background reading and record the meter reading on attachment 3 .
    - 1.3.3.1 Set the meter high voltage to between 1/3 and 1/2 of the voltage plateau.
    - 1.3.3.2 Record the selected high voltage setting on attachment 3.

1.4 INSTRUMENT BACKGROUND

- 1.4.1 Perform an instrument ***background*** as follows:
    - 1.4.1.1 Using the four background blocks, perform six-one minute counts (with the instrument set at the selected voltage) and set in the scaler mode.
    - 1.4.1.2 Record these readings on attachment 3
    - 1.4.1.3 Average the six readings and record the result on attachment 3.

1.5 CALIBRATION SOURCE BLOCK DATA

- 1.5.1 Record the source block serial number on attachment 3
- 1.5.2 Perform six one minute source block counts
- 1.5.3 Record the results on attachment 3
- 1.5.4 Average the source block cpm and record the result on attachment 3
- 1.5.5 Subtract the average background (recorded on attachment 3) from the average source block cpm .

1.5.6 Record this number as the net average on attachment 3.

1.6 ACTIVITY CALCULATION

1.6.1 Perform the calculation on attachment 3 to determine the activity cutoff value for 7.2 pCi/g.

1.6.2 Sign attachment 3

1.7 CALIBRATION STICKER

1.7.1 Complete the information required on attachment 4 and attach it to the side of the instrument.

1.8 DRUM CALIBRATION PROCEDURE

1.8.1 If the instrument and detector is also going to be used as a downhole Gamma logger the following calibration must also be performed.

1.8.1 After the instrument and detector have been calibrated for surface scanning, perform the following.

1.8.1.1 Connect the detector and the instrument with a 15 foot connecting cable.

1.8.1.2 Record the standard picocuries per gram for each calibration drum and record them on attachment ***5***

1.8.1.3 Calibration Geometry must be the same as the Field Geometry, i.e. obtain a sample of the geoprobe steel pipe and insert it into the PVC calibration drums and place the down hole probe inside the geoprobe pipe.

1.8.1.*4* Take three one minute readings in each of the calibration drums located at the REF, and record the reading in the appropriate column on attachment 5

1.8.1.*5*Average the each three one minutes and record the result on attachment 5

1.9 ACTIVITY CALCULATION FOR WELL LOGGING

1.9.1 Perform a linear regression for the average readings for both the calibration drums equipped with steel augers as well as the PVC piping

1.9.2 Record the result on attachment 5

1.9.3 Calculate the activity for 5 pCi/g and & 7.2 pCi/g and record the results on attachment 5

1.9.4 Sign Attachment 5 and forward it for approval

1.10 CALIBRATION STICKER

1.10.1 Complete the information required on attachment 4 and attach it to the side of the instrument.

Ludlum Model 2221/44-10 Calibration

Model 2221 serial number: _____

Probe 44-10 serial number: _____

Date: _____

Scaler Linear Check

Pulser model/serial number: _____ / _____

Calibration Due Date: _____

Threshold set to 100 mv. _____ **(tech. init.)**

Pulser setting in cts.	Multiplyer	As Found Scaler reading in cts.	After Adjustment Scaler reading in cts.
_____	X1	_____	_____
_____	X10	_____	_____
_____	X100	_____	_____
_____	X1000	_____	_____

Voltage Plateau

Source isotope/serial number: _____ / _____

BKGD PLATEAU		SOURCE PLATEAU	
volts	counts	volts	counts
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

operating voltage selected: _____

Ludlum Model 2221/44-10 Calibration

Model 2221 serial number: _____

Probe 44-10 serial number: _____

Date: ☐ window verified at about 3830

Instrument BKGD

1 minute BKDG counts

_____ _____

_____ _____

_____ _____

Average: _____

Source Block Data

Source block ID: _____

1 minute Source Block counts

_____ _____

_____ _____

_____ _____

Average: _____ cpm Net Average: _____ cpm

Activity Calculation

Net Average source count rate of: _____ cpm divided by 10 =_____

Times 7.2 = _____ (A)

Square root of (A) = _____ times 2 = _____ (B)

(A) plus the average BKGD = _____ CPM/7.2 pCi

The cutoff value is: _____ (CPM/7.2 pCi minus (B))

Calibration performed by: _____ DATE: _____

Calibration approved by: _____ DATE: _____

ATTACHMENT 4
CALIBRATION STICKER

SCALER # __________ PROBE # __________
CAL DATE __________ TECHNICIAN __________
CAL DUE __________ VOLTAGE SETTING __________
7.2 pCi/g = __________ CPM SOIL CONCENTRATION __________ DOWNHOLE LOGGING __________

Check
Applicable Line
Geoprobe Pipe _____
PVC Drum _____
Auger Drum _____
Cable Length _____

SCALER # __________ PROBE # __________
CAL DATE __________ TECHNICIAN __________
CAL DUE __________ VOLTAGE SETTING __________
7.2 pCi/g = __________ CPM SOIL CONCENTRATION __________ DOWNHOLE LOGGING __________

Check
Applicable Line
Geoprobe Pipe _____
PVC Drum _____
Auger Drum _____
Cable Length _____

SCALER # __________ PROBE # __________
CAL DATE __________ TECHNICIAN __________
CAL DUE __________ VOLTAGE SETTING __________
7.2 pCi/g = __________ CPM SOIL CONCENTRATION __________ DOWNHOLE LOGGING __________

Check
Applicable Line
Geoprobe Pipe _____
PVC Drum _____
Auger Drum _____
Cable Length _____

SCALER # __________ PROBE # __________
CAL DATE __________ TECHNICIAN __________
CAL DUE __________ VOLTAGE SETTING __________
7.2 pCi/g = __________ CPM SOIL CONCENTRATION __________ DOWNHOLE LOGGING __________

Check
Applicable Line
Geoprobe Pipe _____
PVC Drum _____
Auger Drum _____
Cable Length _____

SCALER # __________ PROBE # __________
CAL DATE __________ TECHNICIAN __________
CAL DUE __________ VOLTAGE SETTING __________
7.2 pCi/g = __________ CPM SOIL CONCENTRATION __________ DOWNHOLE LOGGING __________

Check
Applicable Line
Geoprobe Pipe _____
PVC Drum _____
Auger Drum _____
Cable Length _____

SCALER # __________ PROBE # __________
CAL DATE __________ TECHNICIAN __________
CAL DUE __________ VOLTAGE SETTING __________
7.2 pCi/g = __________ CPM SOIL CONCENTRATION __________ DOWNHOLE LOGGING __________

Check
Applicable Line
Geoprobe Pipe _____
PVC Drum _____
Auger Drum _____
Cable Length _____

ATTACHMENT 5
DETECTOR CALCULATION

DETECTOR TYPE _____ SER #_____

CALIBRATION DRUMS W/PVC PIPING: CABLE LENGTH _____ DIAMETER OF PIPE _____ SCH. OF PIPE _____ 40, _____ 80

DRUM NUMBER	pCi/g	1ST COUNT (cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
CD-1	1.7				
CD-8	12.9				
CD-7	23.4				

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g
A= R= 5.0 PCi/g =_____CPM
B= 7.2 PCi/g =_____CPM

CALIBRATION W/STEEL HOLLOW STEM AUGER PIPING: CABLE LENGTH _____ DIAMETER OF PIPE _____ SCH. OF PIPE _____ 40, _____ 80

DRUM NUMBER	pCi/g	1ST COUNT(cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
10	2.4				
12	5.8				
13	22.4				

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g
A= R= 5.0 pCi/g =_____CPM
B= 7.2 pCi/g =_____CPM

CALIBR. DRUMS W/PVC & GEOPROBE STEEL PIPING: CABLE LENGTH _____ DIAMETER OF PIPE _____ SCH. OF PIPE _____ 40, _____ 80

DRUM NUMBER	pCi/g	1ST COUNT(cpm)	2ND COUNT(cpm)	3RD COUNT(cpm)	AVERAGE COUNT
CD-1	1.7				
CD-8	12.9				
CD-7	23.4				

LINEAR REGRESSION FORMULA Y= A + BX WHERE Y= CPM AND X= pCi/g
A= R= 5.0 pCi/g =_____CPM
B= 7.2 pCi/g =_____CPM